Economic valuation of coastal erosion in Vietnam: an empirical approach

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Economic valuation of coastal erosion in Vietnam: An empirical approach

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Abbreviations

AIC	Akaike Information Criterion
ASC	Alternative Specific Constant
BIC	Bayesian Information Criterion
CCNDPC	Central Committee for Natural Disaster Prevention and Control
CEM	Coastal Erosion Management
CVM	Contingent Valuation Method
DARD	Department of Agriculture and Rural Development
DCE	Discrete Choice Experiment
GAM	Generalized Addictive Model
GDP	Gross Domestic Product
GIS	Geographical Information System
G-MNL	Generalized Multinomial Logit Model
IPCC	Intergovernmental Panel on Climate Change
LCM	Latent Class Model
MARD	Ministry of Agriculture and Rural Development
MIXL	Mixed Logit Model
MLHS	Modified Latin Hypercube Sampling
MNL	Multinomial Logit Model
RUM	Random utility model
S-MNL	Scaled Multinomial Logit Model
SP	Stated Preference
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
VDMA	Vietnam Disaster Management Authority
VHLSS	Vietnam Household Living Standard Survey
VINASARCOM	Vietnam Committee for Incident, Disaster Respondents, Search and Rescue
VND	Vietnam dong
WH	World Heritage
WTA	Willingness To Accept
WTP	Willingness To Pay
WTTC	World Travel and Tourism Council

Résumé

L'objet de cette thèse est la mesure de la valeur économique qu'attribuent les touristes et les résidents aux programmes de gestion de l'érosion côtière à Hội An, au Vietnam. La ville de Hội An - site classé au patrimoine mondial de l'UNESCO - a été choisie car il s'agit d'une destination touristique au Vietnam dont un des atouts, sa plage, subit une forte érosion côtière depuis des années. Cette érosion a entraîné des dommages croissants non seulement aux biens et moyens de subsistance des résidents mais aussi aux activités touristiques.

Le chapitre 1 introduit la thèse. Le contexte de la gestion de l'érosion côtière au niveau mondial et au Vietnam est tout d'abord présenté. Les principales questions quant à l'évaluation économique de la gestion de l'érosion côtière sur lesquelles la thèse se concentre, sont ensuite abordées et mises en perspective au regard de la littérature existante. Un résumé des chapitres de la thèse est ensuite donné fournissant des détails sur le cas d'étude, à savoir la ville de Hội An, sur l'enquête et l'expérimentation de choix discret, et, finalement, sur les contributions majeures de la thèse.

Le chapitre 2 se focalise sur l'évaluation des préférences des touristes quant aux programmes de gestion de l'érosion côtière à Hội An et sur leurs consentements à payer pour les attributs de ces programmes. En se basant sur une expérimentation de choix discret (DCE) impliquant 200 touristes ayant visité Hội An en 2018 et sur l'estimation de modèles logit mixte (MIXL), l'étude capture les valeurs d'usage direct et indirect des plages et fournit plusieurs résultats importants. Ainsi, il existe une hétérogénéité de préférence entre les touristes nationaux et étrangers. Les touristes nationaux soutiennent les constructions de protection en dur tandis que les touristes étrangers préfèrent aussi les structures de protection souples que celles en dur. Alors que les touristes étrangers apprécient la présence d'arbres sur les plages, les touristes nationaux préfèrent une plage avec à la fois des restaurants et des arbres. Contrairement à la littérature existante, notre étude montre que les touristes soutiennent les structures de protection visibles

sur la plage, même si ces structures en dur peuvent affecter l'esthétique naturelle de la plage. Les résultats montrent qu'en moyenne, les touristes sont prêts à payer \$13.295 pour mettre en œuvre des programmes de gestion de l'érosion côtière et améliorer la situation actuelle de la plage, ce qui représente une contribution annuelle potentielle totale de \$42.5 millions de la part des touristes venant à Hội An chaque année.

Le chapitre 3 s'intéresse aux préférences des résidents locaux pour un programme de lutte contre l'érosion côtière à Hội An et comment la reconnaissance du problème de l'érosion côtière par ces derniers et leur niveau d'éducation affectent leurs comportements de choix. Se basant sur l'estimation de modèles logit multinomiaux généralisés (GMNL), les résultats empiriques donnent lieu à cinq conclusions importantes. Premièrement, les résidents préfèrent des plages plus larges, dont l'accès est majoritairement public, et avec des arbres et des restaurants. Deuxièmement, les résidents accordent une plus grande valeur à une plage qui est protégée par des structures permanentes solides. En particulier, les résidents ont le plus fort consentent à payer pour les ouvrages hydrauliques rigides construits au bord de l'océan pour freiner les courants d'eau et limiter les mouvements de sédiments, ou épis. Troisièmement, il existe une autre source d'hétérogénéité dans les choix des résidents en addition de l'hétérogénéité dans les préférences pour les attributs. Ces choix peuvent être d'autant plus prédictibles à partir des attributs des programmes de gestion que le niveau d'éducation, la connaissance du problème d'érosion côtière et le niveau déclaré de certitude du choix sont élevés. Finalement, la reconnaissance et l'expérience du problème de l'érosion côtière ont une forte influence sur la préférence des résidents pour les structures de protection.

Le chapitre 4 fournit une comparaison approfondie des préférences des touristes et des résidents pour différents programmes de gestion de l'érosion côtière à Hội An. De plus, par la mise en œuvre d'une expérimentation de choix discrets avec des échantillons différenciés, nous évaluons comment les préférences des répondeurs varient selon les différents segments de plage qui sont affectés par l'érosion côtière de différentes manières. Se basant sur l'estimation de modèle logit mixte à erreurs composées, nos investigations prennent en compte (1) les différences de préférences, (2) l'hétérogénéité des goûts, et (3) les différences d'incertitude dans les comportements de choix entre les deux groupes d'enquêtés. Nous constatons ainsi qu'aussi bien les touristes que les résidents expriment de fortes préférences pour une large plage publique protégée par des défenses structurelles. Cependant, les touristes diffèrent des résidents dans la mesure où ils accordent une plus grande valeur à la construction de structures de protection en dur, tandis que les résidents préfèrent les épis qui préservent l'accessibilité à la mer. Les résidents ne sont prêts à soutenir qu'une plage aménagée avec des arbres et des restaurants, alors que les touristes préfèrent une plage vierge avec seulement des arbres. Nos résultats révèlent également une forte hétérogénéité entre les enquêtés, en particulier pour le groupe des résidents. De plus, les résultats de l'estimation suggèrent la nécessité de prendre en compte les caractéristiques spécifiques de chaque segment de plage. En termes d'implémentation pratique, une taxe touristique s'avère être un instrument pertinent pour financer les politiques de gestion de l'érosion côtière à Hội An.

Le chapitre 5 aborde la dimension spatiale de l'évaluation des programmes de gestion de l'érosion côtière. Ce chapitre utilise le modèle MIXL comme spécification de base et incorpore une fonction de la distance à l'objet évalué dans la spécification de l'utilité du statu quo. La distance est capturée non seulement par la classique distance en kilomètres du domicile de l'enquêté à la plage, mais aussi par différents indicateurs quant à la localisation de l'enquêté par rapport à la plage. Les résultats confirment la pertinence de ce choix de modélisation et que les choix sont mieux représentés par une spécification incluant la fonction de distance multidirectionnelle que par un spécification ne prenant en compte que la distance du domicile de l'enquêté à la plage. Plus précisément, les résidents vivant loin de la plage, en particulier dans la zone sud-est, ont un intérêt plus élevé pour la mise en œuvre de programmes de gestion de l'érosion côtière, c'est-à-dire pour s'éloigner du statu quo. Bien que ce résultat soit en contradiction avec ceux de la littérature existante, il pourrait refléter le caractère iconique de la plage de Hội An. De plus, la nature de l'hétérogénéité spatiale dans les préférences des enquêtés pour les programmes de gestion de l'érosion côtière varient en fonction du segment de plage considéré. Ce résultat confirme l'existence d'un bénéfice qu'une gestion de l'érosion côtière génère dans les communautés côtières adjacentes. En outre, le chapitre constate que certaines caractéristiques observées des enquêtés contribuent à l'hétérogénéité spatiale des préférences envers les programmes de gestion de l'érosion côtière, notamment le revenu et le fait d'avoir des enfants.

Dans le chapitre 6, nous concluons brièvement, résumons les implications en termes de politiques économiques et nous indiquons des perspectives de recherche dans l'évaluation de la gestion de l'érosion côtière à Hội An.

Abstract

The objective of this thesis is to assess the economic valuation of tourists and residents on coastal erosion management programs in Hội An, Vietnam. Hội An - a UNESCO World Heritage Site was selected given the frequency of coastal erosion events which have caused increasing damages to property, tourism activities and the livelihood of local people in an iconic tourist destination.

Chapter 1 gives a brief introduction to this thesis. We present the context of coastal erosion management at the global level and in Vietnam. We recall the main issues in the literature of economic valuation of coastal erosion management that the thesis is focusing on. A summary of the thesis providing details on the case study of Hội An, the discrete choice experiment survey and the contribution of the thesis is remarked.

Chapter 2 aims at assessing tourists' preference of coastal erosion management programs in Hội An and their willingness to pay for each attribute. Using a discrete choice experiment (DCE) involving 200 tourists visiting Hội An in 2018 and the mixed logit model (MIXL), our study captures the direct and indirect use values of beaches and provides several important findings. There exists a preference heterogeneity across domestic and foreign tourists. Domestic tourists support hard protection construction while foreign tourists incline to both soft and hard protection structures. While foreign tourists value the presence of trees on beaches, domestic tourists prefer a beach having both restaurants and trees. Unlike previous literature, our study shows that tourists support visible protection structures on beaches even though these hard measures might affect the natural aesthetics of the beach. Results show that on average, tourists are willing to pay $13.295 for implementing coastal erosion management programs and moving away from the current situation, measuring up to a total potential annual contribution of $42.5 million from all tourists coming to Hội An City per year.

Chapter 3 explores local residents' preference to a coastal erosion program in Hội An and how acknowledgement of coastal erosion problem and level of education affect their

choice behaviour. Using the generalized multinomial logit model (G-MNL), empirical results yield five important findings. First, residents prefer wider, more public beaches having both trees and restaurants. Second, residents place a higher value on a beach that is protected by robust permanent structures. In particular, residents have the highest willingness to pay (WTP) for groynes. Finally, there exists preference and scale heterogeneity across respondents, which are driven by level of education, knowledge of the problem, and the stated level of choice certainty. Fourth, acknowledgement and experience of coastal erosion problem are shown to have a strong influence on residents' preference of protective structures.

Chapter 4 provides an in-depth comparison of tourists' and residents' preferences for different coastal erosion management programs in Hội An. Moreover, by the implementation of a split-sample choice experiment, we assess how preferences of respondents vary across beach segments affected by coastal erosion in different ways. Using an error component mixed logit model, we take into account (1) differences in preferences, (2) taste heterogeneity, and (3) differences in the uncertainty of choice behaviour between two groups. We find that both tourists and residents express strong preferences for a wide public beach protected by structural defenses. However, tourists differ from residents in that they place a higher value on the construction of hard protection structures, while residents incline to groynes, which preserve the accessibility to the sea. Residents are only willing to support a facilitated beach with trees and restaurants, whereas tourists favor more a pristine beach with only trees. Our results also reveal strong heterogeneity across respondents, especially for the group of residents. Moreover, estimation results suggest the need to account for specific characteristics of each beach segment. From a policy perspective, a tourist tax is shown to be a relevant instrument to fund coastal erosion management policies in Hội An.

Chapter 5 brings about the spatial dimension of valuation on coastal erosion management programs. The chapter uses the MIXL model as the baseline specification and incorporates distance decay function into the individual utility. Estimation results confirm that the spatial patterns are complex in different directions and are better represented using a multidirectional distance decay function compared to a unidirectional one. Specifically, residents living far away from the valued beach, especially in the southeast direction have higher utility for implementation of coastal erosion management programs, i.e. for moving away from the status quo. Although the results on a reverse distance decay effect is contrary to common findings in the literature, it might reflect the iconic sign of Hội An beach. Moreover, the spatial patterns of respondents' preferences for coastal erosion management programs vary according to the beach segment considered. This result supports the evidence on spillover benefit that a coastal erosion management generates across adjacent coastal communities. In addition, the chapter finds that some observed characteristics of respondents contribute to the heterogeneity of spatial preferences towards coastal erosion management programs including income and having children.

In chapter 6, we briefly remark conclusion, summarize policy implications and give our perspectives of future research in valuation of management of coastal erosion in Hội An.

Publications

Paper published in a peer-review journal

- Economic analysis of choices among differing measures to manage coastal erosion in Hoi An (a UNESCO World Heritage Site), *Economic Analysis and Policy*, **70**: 529-543, 2021. (with Nguyen, MH., Nguyen, T., Reynaud, A., Simioni, M., Hoang., VN.)

Papers submitted to peer-review journals

- *The preferences and willingness to pay by domestic and foreign tourists for coastal erosion prevention measures for a Vietnamese UNESCO World Heritage site*, (with Nguyen, MH., Hoang, VN., Reynaud, A., Simioni, M., Wilson, C.).
- *How tourists and residents value coastal erosion management programs? New evidence from Hội An (Vietnam), a UNESCO World Heritage Site.* (with Nguyen, MH., Reynaud, A., Simioni, M.)

Presentation in conference

- *Project: Impacts of coastal erosion in Vietnam: Theoretical models and empirical approaches*, AFD workshop 2018, Hanoi, Vietnam. (with Nguyen, MH., Reynaud, A., Simioni, M.)
- *Do heterogeneous tourists and residents value differently coastal erosion management? Evidence from Hội An (Vietnam), a UNESCO World Heritage Site*, EAERE 2019, Manchester, UK and BEE workshop 2019, Uppsala, Sweden. (with Nguyen, MH., Reynaud, A., Simioni, M.)

- *Valuation of coastal erosion policy in Vietnam: Scope insensitivity assessment*, poster presentation, 7th Workshop on non-market valuation 2019, Marseilles, France. (with Nguyen, MH., Nguyen, T., Reynaud, A., Simioni, M.)

Reading note

This thesis consists of an introduction chapter followed by four independent chapters, each one presenting an original contribution on coastal erosion management in Hội An. In order to make each chapter readable independently from the others, some elements are to be found in several chapters. This is particularly the case for the presentation of the context of coastal erosion in Hội An and for the description of the choice experiment conducted with residents or with tourists. It may introduce some redundancy in the thesis but it makes the reading of each chapter easier.

Chapter 1

Introduction

1.1 Coastal Erosion: A major global environmental issue

1.1.1 Importance of the coast

Coastal area plays an important role because it is the connection between the land and the ocean. It has a total length of 1,634,701 km, equals to 402 times of equator length (Martineza et al., 2007). Coastal zone includes diverse types of ecosystems, promotes coastal tourism which amounts to nearly 80% global tourism (UN, 2021), offers recreational, cultural and spiritual activities, provides the shoreline which can protect the inland area from storms and floods (UNEP, 2006), accommodates primary infrastructure (e.g. commercial ports) and makes a living location for human being (Mentaschi et al., 2018). Although the coastal area represents 20% of world land, approximately 40% of total world population lives within 100 km of the coastline and nearly 84% countries are located along the coast with the coastal population density being double than that of global average and three times than inland population density.[1] There are more than 3 billion people's livelihoods depending on marine and coastal biodiversity. It is estimated that the marine and coastal resources has a market value of $3 trillion per year, equals to about 5% of global world GDP (UN, 2021).

1.1.2 The problem of coastal erosion

In the face of climate change and variability, coastal area is dramatically dealing with hazard risks. In combination with ocean warming and extreme climate events, accelerated sea level rise is reported with a globally rise of, on average, 3.6 mm per year from 2006 to 2015, equals to 2.5 times of that in the period of 1901-1990. This rise, jointly with human pressure, results in serious coastal hazards (IPCC, 2019). Besides flooding and salinization, one of the main coastal hazards is erosion. The overall eroded coastal areas are estimated at nearly 28,000 km^2 in the period of 32 years (1984-2015),

[1]https://www.unep.org/explore-topics/oceans-seas/

among that, Asian and Caspian coasts contribute for 50% of global changes per unit coast (Mentaschi et al., 2018). Vousdoukas et al. (2020) identify several coastal change projections under different representative concentration pathways (RCP) by IPCC. They point out a possibility of extinction of 50% global sandy beaches by 2100, and emphasize the necessity of effective mitigation policies. Under the absence of higher intensive adaptive measures, it is predicted that annual coastal erosion damages will be at 2-3 times larger by the end of the century (IPCC, 2019). The coastal hazards risk varies by location, among that, low-lying coastal areas including deltas in Southeast Asia are of the main hotspots which are the most vulnerable to coastal risks (World Bank, 2010; Vousdoukas et al., 2020).

1.1.3 The necessity of coastal management

The management and protection of the coast is one of priorities. At global level, United Nations Conference on Environment and Development in 1992 proposed a comprehensive plan of action to balance the environment and development, namely Agenda 21. They emphasized the need of protection of the coasts which host most of world's population and highlighted the international cooperation for management of coastal area and marine environment as directive in:

> "This requires new approaches to marine and coastal area management and development, at the national, subregional, regional and global levels, approaches that are integrated in content and are precautionary and anticipatory in ambit.
>
> Coastal States commit themselves to integrated management and sustainable development of coastal areas and the marine environment under their national jurisdiction."

The Agenda 21 (chapter 17.19 and 17.29) pointed out coastal erosion and siltation as of particular concern on the degradation of marine environment and promoted priority actions to control coastal erosion and siltation.

Moreover, the United Nations Millennium Summit in 2000 on setting the eight goals on improving lives in the world's poorest had targeted on the protection of 8.4 % of global coastal marine areas by the year of 2014. However, it was reported in 2015 that only 0.25% of marine areas are conserved, stressing the urgence of taking action for the management of coastal and marine areas (UN, 2015). In 2015, all UN countries agreed on higher ambitious action by a commitment on 17 Sustainable Development Goals by 2030. One of the main goals is about the conservation of ocean, coastline and marine environment, highlighting the climate risk that coastal areas and low-lying coastal countries are facing. It aims at protecting more than 10% of coastal and marine areas in accordance with national and international law.

1.1.4 Concepts and terminology of coastal erosion management

What is exactly coastal erosion management? In this section we describe terminology relating to coastal erosion management.

Coastal area

The coast is the connection between the land and the ocean, however, there are different definition of coastal area depending on the research purpose (Kay and Alder, 2005). In terms of biophysical perspective, coastal area covers aquatic-terrestrial interactions (Martineza et al., 2007), which include both dry land and ocean space. With respect to policy-oriented view, coastal area is based on a limitation of a land-sea interface that is normally defined by one of four options: fixed distance (fixing a distance from the coastline), variable distance (setting a boundary that varies along the beach based on several characteristics such as administrative boundaries, physical and biological attributes), usage-based definition (defining area according to the purpose of coastal management policy, for example, a coastal area for marine pollution management or coastal erosion management) or hybrid definition (a mixed type, which is commonly used by governments) (Kay and Alder, 2005).

Coastal erosion Coastal erosion is "the permanent loss of sand from the beachdune system and strongly depends on the type of coast (exposure, wave climate, surge levels, sediment composition, beach slope). Coastal erosion has both cross-shore and long shore components" (van Rijn, 2011).

Coastal erosion management

Coastal erosion management (CEM), according to Encyclopedia of Coastal Science (Rangel-Buitrago and Neal, 2018), is defined as:

> "the dynamic, multidisciplinary, and interactive approach in responding to coastal erosion processes to prevent or mitigate economic and social losses. CEM requires a detailed knowledge of coastal processes, sediment behavior, and interchange within the coastal zone (offshore, shore, and inland), and how changes, both natural and due to human activities, alter these controls of erosion."

Coastal erosion management is normally a part of coastal management program which requires a long-term project and a collaboration of many stakeholders. A cycle of coastal erosion management traditionally involves a rational and strategic decision making process which consists of: (1) identification of erosion problems which requires an understanding of coastal erosion process and its causes; (2) planning step which involves proposing possible options, assessing its impacts and expected time frame of the outcomes and determining measures to be implemented; (3) the financial process and formal approval; (4) implementation; and (5) evaluation of the chosen option. Figure 1.1 summarizes the different steps involved in a cycle of CEM.

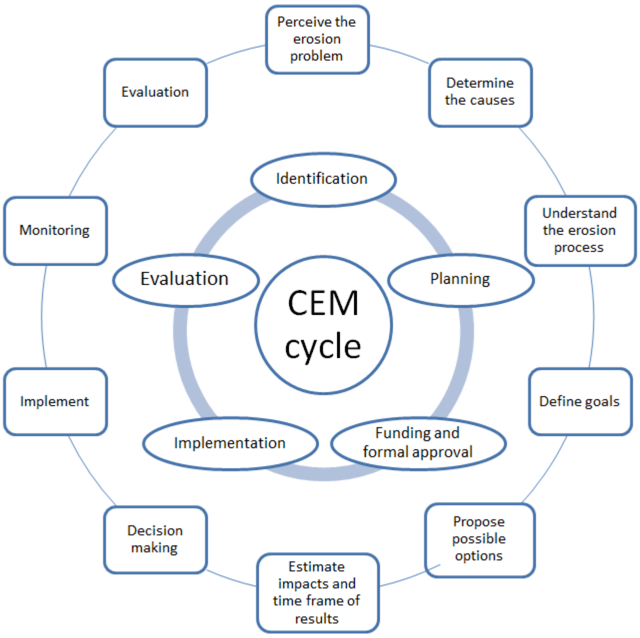


Figure 1.1: Coastal erosion management cycle
Source: Modified from Williams et al. (2018); Rangel-Buitrago and Neal (2018); Kay and Alder (2005)

1.1.5 Coastal erosion management approach

Approach of coastal erosion management can be classified into five categories (Rangel-Buitrago and Neal, 2018). Table 1.1 presents the advantages and drawbacks associated with these five approaches.

The first and most traditional type is *defence*, which means maintaining or advancing the coastline with the objective to limit the damage of the coast by erosion and protect the property and vulnerable areas. This strategy involves in building hard, soft measures or land claim as barries to mitigate impact of waves and manage the transport process of sediment (Rangel-Buitrago and Neal, 2018). Hard structures, for example, groynes, seawalls, concrete revetment, and stair revetment are made of hard materials such as concrete, cement or rock. Soft structures imply restoring the beach using sand by soft visible intervention in order to adapt the natural process. Examples of soft structures are beach nourishment (adding sediment or sand to replace the deficit beach), sandbags, construction of stable bays (creating a bay to lengthen the coast in order to attenuate wave energy per unit length of the coastline). Land claim means advancing the coastline by adding land to the previously inter-tidal areas in order to mostly serve economic purposes such as constructing ports (e.g, Hong Kong) or urbanization (e.g, Halong Bay).

The second type is *accommodation* which is to keep the usage of eroded coastal areas rather than to focus on defending against damage. Typology of accommodation can be classified into two lines: technology and information system. Technology involves physical changes: for instance, building codes (constructing buildings and infrastructure under specific recommendations on how to mitigate wave impacts and manage erosion) or floating agricultural systems (planting crops in coastal area for a long time in an attempt on soil creation and protection from coastal erosion). Information system allows an awareness on the risk of coastal erosion issue and proposes suitable response to mitigate impacts. This strategy consists of mapping/zoning (mapping areas under different level of erosion risk), and early warning systems (anticipating and forecasting the occurrence of an coastal erosion event). This strategy can be considered as the first step among other approaches to manage coastal erosion. It is applied more to flood prone areas or flood hazards (Williams et al., 2018). Moreover, the implementation of this approach leads to the change in lifestyle, social and cultural interaction of coastal community. Accordingly, it needs of a long-term planning and an acceptance of the loss of some coastal areas.

The third type is the *usage of ecosystem*.[2] This approach creates ecosystems along the coastline, aiming at both improving ecosystem quality and protecting it from erosion by creating sediment and dissipating wave energy. Examples are coral reefs, wetlands by mangroves, dune vegetation. This strategy is more sustainable and effective in term of cost. However, since ecosystems require a large area to develop and their recovery after loss cannot be immediate, the application of this option is subject to the level of erosion, coastal conditions, hydrodynamics and habitats.

The fourth type is *managed retreat* which means to move population and infrastructures away from eroded areas. In practice, retreat implementation may depend on institutional capability and trust. It is because relocation might be sometimes considered needless by

[2] This approach is sometimes classified as "accommodation" type (e.g. Williams et al., 2018). We follow typology presented in Encyclopedia of Coastal Science (Rangel-Buitrago and Neal, 2018).

inhabitants due to the fact that they will lose their property and be impacted on their culture and heritage when settling down in new area (Williams et al., 2018). Besides, this approach is more suitable for large areas because it requires lands to relocate. This approach includes management realignment (moving defense structures to allow the restoration of new inter-tidal zones in order to reduce wave impact and sediment transport), avoidance (prohibiting the construction of new infrastructure or property in affected coastal areas), acquisition (acquiring coastal areas by government in order to conserve them) and relocation (actively/passively/long-term relocating of a person or a community from eroded areas to another areas).

The final type is *sacrifice* which acquiesces the damage of property and infrastructure when other interventions are not practicable. Notwithstanding, it is sometimes considered as the most economic and safest option since the reconstruction in vulnerable areas may face damages in the future (Rangel-Buitrago and Neal, 2018). Moreover, implementation of this strategy requires thoroughly concerns on: (i) recognition of the rationale behind the decision, (ii) assessment of its viability by demonstration sites, and (iii) analysis of geomorphological and ecological conditions, pointing out the costs and benefits of letting the erosion events happen. (Williams et al., 2018).

Table 1.1: Advantages and disadvantages of coastal erosion management approaches

Types	Advantages	Drawbacks
Defence		
Hard structures	1. Present immediate protection 2. Prevention of physical damages to property, infrastructure and land loss 3. Provide a sense of being apparently protected to the community	1. Block sediment supply and cause habitat loss 3. Bathing risks (e.g. bottom holes, boating hazards) 4. Usually costly 5. Destroy of aesthetic visualization of the beach 6. Limited beach access 7. Possibly move erosion to adjacent areas
Soft structures	1. Maintain the natural appearance	1. High maintenance cost
Land claim	1. Gain of additional coastal land for diverse purposes	1. Loss of coastal ecosystem, especially previously intertidal habitats 2. Prevention of natural ecosystem adjustment 3. Acidification (by bacteria in new sediments) and pollution (by dragging sediments)
Accommodation	1. Low cost or no cost of implementation	1. Change of lifestyle, social and cultural interaction of community 2. Reduce living conditions (safety and health) due to the exposure to a gradual erosion
Use of ecosystems	1. Conserve natural habitat, enhance water quality and produce fisheries 2. Generation of recreational spaces 3. No initial cost in existing coastal ecosystems	1. Require large space 2. Require the flexibility because the recovery after hazard events (e.g. storm damage) is prolonged or even lost
Managed retreat	1. Gradual resumption of erosion and sediment process 2. Build long-term resilient community	1. Only feasible in specific areas. e.g. large areas or low-quality agricultural lands 2. Loss of property and social cost of relocation
Sacrifice	Safe option	Loss of property

Source: Williams et al. (2018); Rangel-Buitrago and Neal (2018)

1.2 Coastal erosion in Vietnam

This section introduces current status and the management of coastal erosion in Vietnam. Main approaches for managing coastal erosion and the organizational structure on state management of coastal erosion in Vietnam are further discussed.

1.2.1 Context and status of coastal erosion in Vietnam

Context

Vietnam is a coastal country which has about 3260 km coastal line. There are 28 coastal provinces over a total of 63 provinces (Figure 1.2). The coastal area is approximately 1 million km^2, accounting for three time larger than the land area (Cong et al., 2014).

Figure 1.2: The Vietnam coastline

The current status of coastal erosion

Vietnam has been ranked among one of the most affected countries by climate change and coastal disaster (GFDRR, 2015). Due to dynamic coastal process, most of coastal provinces are facing with erosion. The map for eroded area in coastal districts is presented in Figure 1.3. It can be observed from the map that the most severe coastal erosion has been occurred in the southern and central provinces at the level up to 370 hectare of eroded area, whereas the coastal erosion in the north is at lower level of severity.

Figure 1.3: Situation of erosion in Vietnam coastline

Based on the morphological structures and geological factors, the coast of Vietnam can be divided into five regions. These five regions associate with different characteristics and the current status of coastal erosion. Figure 1.2 and Table 1.2 present more information on these regions. Overall, the erosion process along Vietnam coastline is complicated subject to the shoreline structures and marine mechanism Cong et al. (2014) and varies across regions. The erosion dominates in most regions, although the accretion increases in some areas such as from Do Son to Nga Son.

Table 1.2: The status of coastal erosion in Vietnam by regions

Region	Characteristic	Coastal erosion status
1. Mong Cai to Do Son	- cliffs, low rock coasts, and low foreshores with limestone, gravel, grit, sand, clay, and mud - short rivers bring gravels and sands but little silt - offshore limestone islands contribute to protect the coast	- erosion occurs locally along short coastal parts - erosion has effectively reduced by the plants of mangroves since 1993
2. Do Son to Nga Son	- typical deltaic depositional coastline - location of many large, silt-laden river mouth	- accretion dominates (the maximum accretion is up to 100 m/year) - erosion happens in places located far away from the river mouth
3. Nga Son to Hai Van	- consist of sandy and bay beaches - smooth and flat - some mountain ranges create coastal cliffs and rocky shores.	- erosion dominates with increasing speed and intensity - erosion mainly occurs on coasts perpendicular to the direction of the waves
4. Hai Van to Vung Tau	- abrasive cliffs, low cliffs, dunes, gulfs, and river mouths - many ranges or blocks of mountains stick out to the shore	- erosion rate is more than 100 m/year in some areas - 94% of the total eroded coasts are sandy beaches - 10.6% of the coast have been retreated by 200 m of width
5. Vung Tau to Ha Tien	- comprised of mud and clay - suitable for low foreshores - in some places, beaches are absent due to the locating of hard rock cliffs next to the shore	- coastal erosion becomes a common issue since 1960 and happens in most estuaries - it causes severe impacts (floods and saline instrusion) - it differs across provinces, ranges from 10m-30m/year

The main drivers of coastal erosion

There are three main drivers of coastal erosion in Vietnam: natural process, extreme events, and human activities. Natural factors consist of wave and currents, sea level rise, the physical structures and geological features of the coast. Extreme events include storms and storms surges. Human activities involve the construction of inappropriate embankments and irrigation systems, the infrastructure of hydro-power and water control in river basins, sand mining, coral exploitation, and deforestation of mangroves and coastal forests (Cong et al., 2014).

1.2.2 Coastal erosion management in Vietnam

The main approaches

The management of coastal erosion in Vietnam requires a combination of different approaches in order to be suitable with a specific coastal area. It is based on a cooperation of national and local management and the overall socioeconomic development planning. There are two main category of approaches of coastal erosion management in

Vietnam including defence and use of ecosystems (Cong et al., 2014).

There are two common types of defence in Vietnam: hard structures (including revetments, seawall, dikes) and soft structures (including sandbags, nourishment). Use of ecosystems consists of mangrove forest plantation or wetland restoration. They are implemented along the coastline through different projects under the government investment and support from international organizations. Examples of implementation of coastal erosion management approaches in Vietnam are described in Table 1.3.

Table 1.3: Coastal erosion management approaches implemented in the five coast regions

Regions	Approaches
Mong Cai to Do Son	Mangrove forest Sea dikes
Do Son to Nga Son	Sea dikes Mangrove forest
Nga Son to Hai Van	Sea dikes
Hai Van to Vung Tau	Sea dikes Estuarines dyke
Vung Tau to Ha Tien	Sea dikes

Although preventative approaches are effective to protect erosion in a number of coastal regions, many of projects have failed due to the lack of thorough consideration of dynamic process of the coast. For example, sandbags which were applied in some areas including Phan Thiet (Binh Thuan), Hội An (Quang Nam) were damaged under the impact of strong waves, tides and storms, badly impacting on habitat ecosystems and aesthetic visual of the beach.

Laws and programs on management of coastal erosion

Several laws and regulations have been promulgated with the subject to prevent and control the natural disaster including erosion. Focusing on the protection of coastal erosion, there are regulations on the construction of dikes, restorations of mangroves and the management of river and coastal erosion. Moreover, several plans and strategies to promote the socio-economic development in response to the climate change and natural disaster are designed at national and regional level. These programs include strategies for river and coastal erosion responses. A summary of relevant laws and programs that have been applied in Vietnam is given in Table 1.4.

Table 1.4: Relevant laws, regulations and programs on coastal erosion management in Vietnam

Type	Name	Promulgation year	Subject
Law	Dike management	2006	Management of dikes
Law	Water resources management	2012	Management of water resources, including surface-water, groundwater and seawater.
Law	Natural Disaster Prevention and Control	2013	Disaster Management including erosion
Law	Natural resources, environment of sea and islands	2015	Natural resources and environment of sea and island
Regulation	Handle of river and coastal erosion	2011	River and coastal erosion
Regulation	Protection of riverbeds and riverbanks	2020	Management of riverbeds, riverbanks, including sand mining and river erosion
Program	Program on Community Base Disaster Risk Management	2009	Improvement of community awareness and community-based management of natural disaster risks
Program	National strategy for Climate Change	2011	measures of adapting to impacts of climate change
Program	Master planning of Incident and Disaster Response and Search and Rescue to 2020	2014	Disaster Response, Search and Rescue
Program	Planning on Socio-Economic Development of Central Coastal Line to 2020, with a vision to 2030	2014	Socio-Economic Development
Program	Strategy for sustainable development of Vietnam's marine economy to 2030, with a vision to 2045	2020	Sustainable development of marine economy
Program	Prevention of river and coastal erosion to 2030	2020	River and coastal erosion

Organizational structure of coastal erosion management in Vietnam

The management of coastal erosion in Vietnam is not treated solely by a distinct institutional office but is considered as one of natural disasters under the Natural Disaster Management Program. The management of coastal erosion in particular and of natural disaster in general in Vietnam involve in different institutional levels and organizations. Figure 1.4 presents the structure of natural disaster management in Vietnam.

At national level, there are Central Committee for Natural Disaster Prevention and Control (CCNDPC), and Committee for Incident, Disaster Respondents, Search and Rescue (VINASARCOM) which are established by the Prime Minister and under the corporation of different ministries and sectors. The Ministry of Agriculture and Rural Development (MARD) is the lead of CCNDPC over the consortium of Vietnam

Disaster Management Authority (VDMA) which delivers the tasks of state management on natural disaster prevention and control. The CCNDPC, in coordination with VINASARCOM, guides, directs and monitors localities in the response to natural disaster. At the local level, Committee for Natural Disaster Prevention and Control and Search and Rescue is in charge of natural disaster management at provincial and district level. Their guidelines and monitors are given based on advice from advisory authorities which are Department of Agriculture and Rural Development (DARD) at provincial level and Agriculture and economic division at district level.

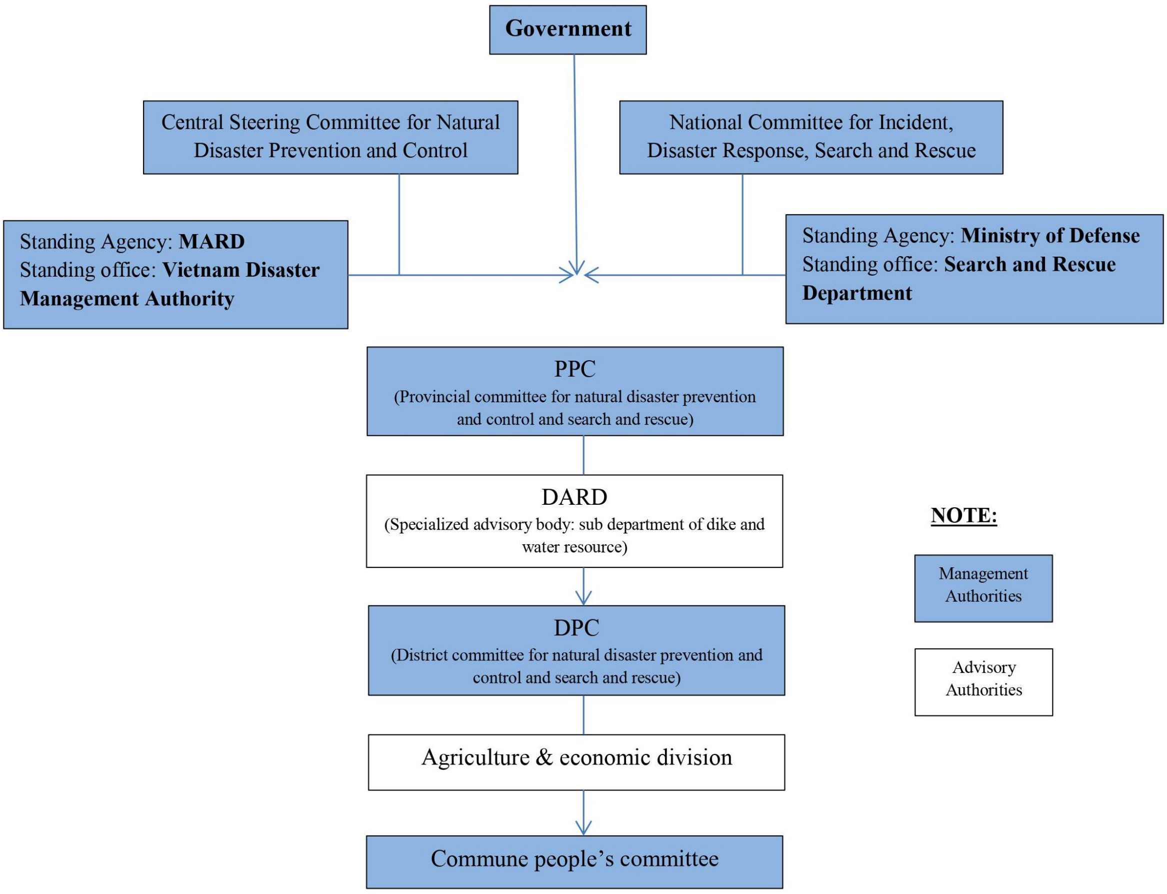


Figure 1.4: Organizational structure of natural disaster management in Vietnam
Source: Modified from Cong et al. (2014); CFE-DM (2018) and Vietnam Disaster Management Authority website

1.3 Main issues on coastal erosion management valuation

This section gives a brief literature review on the economic valuation of coastal erosion management and discusses five main issues that the thesis is focusing on.

1.3.1 Economic valuation of coastal erosion management program

The valuation of services provided by beaches has been an area of growing interest for researchers (Torres and Hanley, 2016). Revealed preference methods, such as hedonic prices or travel costs, have been used to value the economic benefit and cost of beach erosion management programs (e.g. Taylor and Smith, 2000; Murray et al., 2001; Parsons and Noailly, 2004; Landry and Hindsley, 2011; Thinh et al., 2019). These methods indirectly capture use values from behaviors.

A main part of studies on economic valuation of coastal erosion programs have relied on stated preferences (SP) method thanks to its ability to infer both use and passive-use values by directly asking respondents about their preferences (Segerson, 2017). Within SP methods, the contingent valuation method (CVM) has been widely used in the context of beach management programs. Lindsay et al. (1992); Landry et al. (2003); Dribek and Voltaire (2017); Casey and Schuhmann (2019); Logar and den Bergh (2014); Dixon et al. (2012); Banerjee et al. (2018) are examples of studies that have applied CVM. This SP method is appropriate if a valued object cannot be appraised in terms of different characteristics, or if the changes are not multidimensional (Johnston et al., 2017). However, the literature points out some drawbacks to this method. One of the issues is hypothetical bias, in which respondents tend to report that they are willing to pay for the good, whereas in a real-life scenario they would not be willing, which would lead to an overestimation of the individual's true willingness to pay (WTP) (Whitehead and Blomquist, 2006). Moreover, a divergence between WTP and willingness to accept (WTA) means that, in some cases, the CVM (contingent valuation method) is an inappropriate method for cost-benefit analysis (Kahneman et al., 1990). Another issue is the difficulty of respondents in understanding the effects of the created scenario through textual narratives in CVM (Hoevenagel, 1994). This is why discrete choice experiment (DCE) method is getting increasing popularity in the literature on economic valuation of coastal management. Some studies have highlighted the advantages of DCE compared with other valuation methods. In particular, DCE allows for the inference of more information from respondents, which allows researchers to lower the frequency of ethical protesting, to value objects and evaluate changes in multiple characteristics, and to form a deeper understanding of the trade-offs between different attributes of a good or a policy (Hoyos, 2010; Hanley et al., 2002; Holmes et al., 2017). The literature using DCE to valuate beach management policies includes Huang et al. (2007); Beharry-Borg and Scarpa (2010); Penn et al. (2017); Spencer-Cotton et al. (2018); Ardeshiri et al. (2019); Matthews et al. (2017b); Schuhmann et al. (2016); Oh et al. (2009); Christie et al. (2015).

1.3.2 Several issues on valuation of coastal erosion management

Valuation of different coastal erosion management approaches

Marine and coastal ecosystems provide a wide range of services including provisioning services (e.g. food or raw materials), regulating services (e.g. regulation of climate or coastal hazards such as storm or erosion), cultural services (e.g. tourism, recreation, cultural activities) and supporting services (e.g. species ecosystem) (Christie et al., 2015; Torres and Hanley, 2016). Regulating service is recognized as the key factor for a coastal erosion management program since it reflects the ability to control the erosion process and mitigate damages of erosion. Several coastal erosion management approaches are discussed in section 1.1.5, raising a question: which preventive measure can maximize social welfare? The valuation of alternative coastal erosion management approaches is then necessary to select the effective management program (Whitehead et al., 2008; Landry et al., 2020).

Among the five approaches to CEM (see Table 1.1), defence is a conventional method which has received attention of most studies on valuation of coastal erosion management (see, for example, Oliveira and Pinto, 2020; Marzetti et al., 2016; Matthews et al., 2017a; Johnston et al., 2018). According to these studies, beach nourishment, a soft structure, is placed higher value than general hard structure. However, a beach protected by any defence brings higher welfare than when there is no protection program (more details on the literature are given in Chapter 3 and 4). Managed retreat and accommodation are increasingly popular in developed countries: Landry et al. (2020) in North Carolina, US, Matthews et al. (2017a) in New Zealand and Meyerhoff et al. (2021) for the German Baltic Sea coast.

Unlike previous economic valuation studies which consider hard structure as a general approach, we further explore preference and the trade-offs of different types of structures including soft and hard protection structures. These protection structures are different in the aesthetic impact and accessibility of the beach for recreation activities.

Group-specific preference

Since coastal areas offer a wide range of activities and promote tourism, a diversity of stakeholders benefits from coastal management. Studies on coastal management valuation employ either sampel of tourists (e.g. Logar and den Bergh, 2014; Marzetti et al., 2016) or sample of local residents (e.g. Johnston et al., 2018; Meyerhoff et al., 2021) or sample of both tourists and residents, with further categorical break-down by types of beach user such as in-water and out-water recreationalists (Beharry-Borg and Scarpa, 2010; Penn et al., 2017), domestic or international visitors (Logar and van den Bergh, 2012; Schuhmann et al., 2019), day trippers or tourists (Rulleau and Rey-Valette, 2013). Literature reviews on valuation of coastal erosion management by tourists and residents are further provided in chapter 2 and 3, respectively. A strong preference heterogeneity for a coastal management program is pointed out due to diverse groups of respondents (Rulleau and Rey-Valette, 2013; Banerjee et al., 2018).

Both tourist and residents are pointed out to be willing to contribute on a coastal erosion management program (see, for example, Saengsupavanich et al., 2008a; Johnston et al., 2018). However, in areas where coastal area influences local tourism, tourists and residents are considered as separated groups with potentially different concerns and WTP. For example, Oh et al. (2010) indicate, using a DCE approach, that residents greatly concern about beach regulations and disliked high levels of development, crowding, and noise, while tourists support moderate commercial development and beach access. Christie et al. (2015) suggest that tourists have a higher interest in fish changes than residents, and only residents concern about coastal protection and diving when valuing coastal ecosystem services in the Caribbean beaches. Understanding the group-specific preference is needed for tailoring differentiated coastal erosion management program and pricing policy that can benefits to different subgroups (Beharry-Borg and Scarpa, 2010).

The literature comparing valuation of coastal erosion management program between tourists and residents, uses mostly CVM methods and reports mixed results. Tourists appear to be more willing to pay than residents for a coastal infrastructure in Barbados, a developing country (Banerjee et al., 2018), while both groups have same welfare for beach erosion control in Tunisia (Dribek and Voltaire, 2017). However, Rulleau and Rey-Valette (2013) indicate substantially higher WTP of residents than tourists' for beach protection measures in France.

This thesis aims to contribute to the existing literature by providing the first comparison of preference between tourists and residents for a coastal erosion management program using a DCE approach, enabling to analyze a multi-attribute coastal erosion protection policy.

The effect of the familiarity and experience on preference

The effect of experience on choice behavior is of continuing and prevailing interest in the literature on economic valuation since the early time (see, for example, Bergemann and Valimaki, 2006; Boyle et al., 1993, for valuation of market goods and public goods, respectively)

Previous studies on valuation of environmental goods point out a relationship between experience and the predictability of respondents' choice behaviour and WTP estimates. Experience is reported to play a role on WTP (Alberini et al., 2005; MacMillan et al., 2006). More specifically, WTP for environmental protection program increases for respondents being impacted by a decline of environment (Turpie, 2003; Needham and Hanley, 2019) or for well-informed respondents (LaRiviere et al., 2014). The influence of experience on the choice certainty shows mixed results. For example, this effect is weak in Czajkowski et al. (2015) but significant in findings by Kularatne et al. (2021). Two potential explanations of the effect that experience has on WTP have been suggested: the attachment to the valued goods (Corrigan et al., 2008) and the fact that familiarity with the goods can help respondents to elicit preference (Norwood and Lusk, 2011; Brown et al., 2008; Bateman et al., 2008).

In the case of the valuation of coastal erosion management policy using DCEs, respondents have a certain level of familiarity with the local coastal erosion situation. The prior familiarity and experience of valued goods may have effect on their choice behavior, and that is one of our concerns in chapter 2 and chapter 3.

Spatial preference heterogeneity

Spatial dimension is linked to most issues in environmental economics (Glenk et al., 2020). An expanding literature has paid attention to spatial heterogeneity in stated preference valuation. This is an important concern since information on spatial distribution of values is needed to ensure the reliability of value transfer and benefit aggregation (Valck and Rolfe, 2018). Moreover, ignoring the spatial distribution of values might cause biased estimation and failure to capture welfare heterogeneity, leading to inefficient policy recommendation (Johnston et al., 2015; Glenk et al., 2020).

The presence of spatial patterns has been tested in different stated-preference settings. For instance, the effect of distance on values has been confirmed in forest management (Czajkowski et al., 2017), river restoration (Logar and Brouwer, 2018), ecosystem services (Olsen et al., 2020), marine life protection (Johnston and Ramachandran, 2014), agricultural landscape (Badura et al., 2020). However, the evidence of distance effect is weak in valuation of iconic environmental goods such as Great Barrier Reef (Rolfe and Windle, 2012) or goods that are mostly dominated by non-use value (Loomis and White, 1996; Johnston et al., 2015).

In the context of coastal erosion management, there is a very limited number of stated-preference studies addressing the spatial patterns of values on coastal erosion protection. Luisetti et al. (2011) and Ardeshiri et al. (2019) find mixed evidences on unidirectional distance-decay effect for coastal erosion management. Moreover, it is found that utility does not always monotonically decrease in all direction (Johnston et al., 2015), implying the needs to capture a more complex form of distance effect (Schaafsma and Brouwer, 2013; Logar and Brouwer, 2018).

The thesis further explores the multi-directional spatial patterns of valuation on coastal erosion management and the heterogeneity of spatial preferences that is caused by respondents' characteristics.

Valuation of coastal management in Vietnam

In the context of policy implication, Torres and Hanley (2016) mention explicitly the critical role of environmental valuation and ecosystem cost-benefit analysis in achieving poverty reduction and sustainable livelihood, especially in developing country settings. In Vietnam, the valuation for coastal management in the context of climate change has been assessed in several studies. Mangrove restoration receives attention for its ability to mitigate storm impacts, which is estimated to have annual WTP of $8.64 per resident in Cat Ba biosphere reserve, a northern island (Pham et al., 2018a) and $6.52 per household in Thi Nai lagoon (Quy Nhon, a central coastal province) (Tuan et al., 2014). These studies point out a significant influence of socioeconomic factors and residents' awareness on the importance of mangrove forest on the valuation of mangrove restoration. Coral reef, a marine conservation measure, is estimated at the annual loss of $27.78-31.72 million in the context of climate change and fishing effort scenarios in the case study of Nha Trang Bay (Ngoc, 2019). Borger et al. (2021) propose a new coastal management program focusing on water quality improvement, coral conservation and control of marine plastic pollution in Nha Trang. They point out that the limit of plastic pollution is of residents' highest WTP compared to the improvement of water quality and protection of coral reef. Moreover, coastal erosion, one of the main coastal hazards in Vietnam, is estimated to cause a tourism revenue loss at approximately $29.6 million in 2020 in Hội An, a UNESCO World Heritage Site (Thinh et al., 2019).

The thesis extends the current literature in Vietnam by assessing WTP and providing policy implication for mitigation strategies of coastal erosion in Hội An, a tourism hotspot. The coastal erosion management program proposed in the thesis not only focus on the recreation offered in the beach but also the erosion protection ability.

1.4 Summary of the thesis

In this section, I bring about more details on my thesis including presenting the case study of Hội An and the discrete choice experiment survey, remarking contributions of the thesis to the existing literature and summarizing of chapters.

1.4.1 Case study: Hội An

A brief presentation of Hội An

Hội An is a city located along the central coastline of Vietnam with a total population of approximately 150,000 people. Hội An's ancient town has been listed as a UNESCO World Heritage site since 1999.[3] Thanks to its advantageous geographic location, situated along a river estuary with a deep and easily accessible, protected harbor, it was a crowded international commercial trade port between Southeast and East Asia and the West from the 15th to the 19th century. According to UNESCO (1999), "Hội An is an exceptionally well-preserved example of a traditional Asian trading port." In addition to its authentic architecture, other aspects of its diverse communities including cuisine, living customs, rituals and festivals, crafts, religion, and performing arts, reflect the living heritage that has been well-retained up until now (Brooks, 2008). In addition, its 7 km coast, which is considered among the most beautiful beaches in Vietnam, is one of the most popular attractions in Hội An.

[3] https://whc.unesco.org/en/list/948

Tourism in Hội An

Although the city has historically been engaged in several economic activities, including agriculture, fishing, trading, and craft production such as pottery and woodcarving, its largest economic sector is currently tourism. Because of its listing as a World Heritage Site in 1999, the number of tourists visiting Hội An significantly increased from approximately 160,000 annual visitors in 1999 to approximately 363,000 in 2001. Nearly 2.6 million tourists visited Hội An in 2016, with a stay of 2.31 days on average. This is a noticeably high figure considering Hội An's small and remote area and its population size (Adongo et al., 2017). Tourism and commercial services account for approximately 60% of total municipal revenue [4]. Revenue from tourism can be classified into retail sales of goods, food and beverages, provision of accommodation, transportation, and other services. Among these, the provision of accommodation brings the highest revenue, accounting for approximately 58% of tourism revenue (UNESCO, 2008). Tourism development has had a significant effect on different aspects of residents' life.

Coastal erosion in Hội An

History of coastal erosion in Hội An Hội An is exposed to various climate hazards including flooding, salinity, coastal erosion, river bank erosion, and sea-level rise due to its location at the estuary of a river and on a coastal plain (UN-Habitat, 2014). Coastal erosion has become a serious issue in Hội An because sandy beaches have disappeared in some areas, threatening coastal buildings and houses (Figure 5.1). Viet et al. (2015) report that Hội An's southern coastline retreated by about 500m between 2004 to 2012, and that the northern stretch has been eroding at an alarming rate of 12m per year, on average.

The coastal erosion has resulted in the destruction of buildings and roads and the loss of attractive landscape. In a nearly two-kilometer long stretch at the southern part of Hội An beach, which has been the location of many large, well-known resorts in the last decade, coastal erosion has reached and damaged all shore-adjacent hotels and

[4] Hội An Department of Statistics, 2014

resorts, and the embankment, which has cost several hundred billion Vietnam dong. The coastal erosion that has reached close to the main street has caused the complete loss of sandy beach in the area. The whole beach is continuously being eroded, causing a loss of attractiveness of the area's topography. The loss of beach area, and the damage caused by ongoing construction has had a negative impact on the tourism industry and residents' livelihoods.

Possible causes of coastal erosion in Hội An Severe coastal erosion in Hội An is a result of both natural causes, including morphological changes, sea waves, storm surges, and sediment reduction, and anthropogenic activities, including the misuse of land, sand mining, the construction of irrigation systems, and hydro-power dams (Fila et al., 2016; Agence Francaise de Developpement, 2017). The issue of coastal erosion is predicted to continue in the coming years. With climate change increasing the magnitude and frequency of storm surges and strong waves, Hội An is expected to face a sea level rise of 5 mm per year, and experience regular floods in a quarter of the region by the year 2020 (Fila et al., 2016).

Figure 1.5: Coastal erosion on Hội An beach between 2004 and 2018

Source: Google Earth images of Hội An beach in 2004 and 2018.

Current policies implemented to limit coastal erosion in Hội An Prevention of coastal erosion in Hội An is an urgent issue for authorities and hotel owners, although it requires a considerable amount of investment. Feasible solutions should be effective in preventing erosion and in maintaining beach attractiveness. Currently, in the context of alarming coastal erosion issues in Hội An, several structures have been put along the shoreline by government. Sand bags were placed in some parts to protect the beach from strong waves, maintain the beach width, and preserve the sandy beach; however, they are of low resistance and are unattractive. Another measure that has been implemented are the construction of concrete embankments. These provide strong protection from high waves with low maintenance costs despite the high primary investment costs, but with a detrimental impact on the landscape and recreational activities.

An efficient beach erosion policy should combine beach nourishment and sand protection structures such as groynes and revetments (Agence Francaise de Developpement, 2017). In combination with hard protection which lowers the risk of erosion, sandy beaches facilitate swimming at the sea, and retain beach's natural appearance. These solutions require a high initial investment, which could amount to around million $8.7-30.2 and substantial maintenance costs of approximately million $25-48.6 for 20 years (Fila et al., 2016). Based on thorough technical research and the current implemented measures, we will investigate the preferences of residents and visitors of Hội An for various coastal erosion management programs. These programs focus on four types of protection structures, including: sandbags, groynes, stair revetments, and concrete revetments. These structures are proposed in combination with beach nourishment.

1.4.2 Discrete choice experiment survey

We employ a discrete choice experiment survey to explore the economic valuation of both tourists and residents to a coastal erosion management program in Hội An.

In order to deeply understand the issue of coastal erosion and its current management in Hội An, a series of seminar and meetings is organized. A seminar namely "International multidisciplinary Researches in Economics, Environment and Technology" was organized in Hội An in 4 August 2017 with participation from local authorities and researchers in order to gather information of coastal erosion management in particular and natural disaster management in general in Hội An. Besides, we had a meeting with people working on Vietnam Administration of Seas and Islands, Vietnam Disaster Management Authority- Central Branch, Thuy Loi University (Water resources university), Natural Resources University.

The questionnaire content is then developed based on the recent literature on economic valuation of coastal erosion management and our knowledge of coastal erosion management in Hội An. The survey consists of four parts. The first part is devoted to residents' and visitors' attitudes towards the coastal erosion issue, information about the visitors' trip to Hội An beach, and respondents' knowledge about erosion in Hội An. The second part is the DCE section. The third part addresses demographic questions. The final part deals with respondents' personal economic preference.

The survey is conducted with a mixed mode of computer-administered and in-person survey. The pilot survey was undertaken of a sample of 120 households and 80 visitors from 23 to 31 March 2018, while the final was organized from 14 to 21 July 2018 with a sample of 399 households and 200 visitors.

Further details of the questionnaire and the survey are presented in the following chapters.

1.4.3 Contributions

The main objective of the thesis is to investigate the economic valuation by residents and tourists of coastal erosion management programs in Hội An and to provide policy implications for local authorities. The thesis makes several contributions on the existing literature.

- First, although there are some studies focusing on coastal management in Vietnam, the thesis is the first study using DCE to value coastal erosion protection programs in Vietnam. These programs capture both protection ability and recreational features.

- Second, in the same settings, we consider a wide range of coastal erosion management policies including hard measures (concrete revetment, stair revetment and groynes) and soft protection measures (beach nourishment, sandbags). It should be noted that these three hard protection measures differ in terms of aesthetic impact and on accessibility of the beach for recreation activities.

- Third, we explore tourists' perceptions of coastal erosion management strategies in a touristic site with World Heritage status in a developing country where erosion is a prominent and visible threat (chapter 2).

- Fourth, accounting for preference heterogeneity for coastal erosion management program, we examine the impact of residents' knowledge of coastal erosion and level of education on their choice behaviour (chapter 3).

- Fifth, it is the first study to use a DCE to examine the difference in preferences between residents and tourists for a coastal erosion management policy (chapter 4).

- Sixth, we account for the spatial preference heterogeneity of a coastal erosion management policy by testing multi-directional distance decay effect, visualizing and predicting WTP for implementation of coastal erosion management program of non sampled residents (chapter 5).

- Finally, to account for the fact that coastal erosion in Hội An is not affecting all beach segments in the same way, we implement a split-sample DCE. This approach makes possible to conduct a detailed assessment of individual preferences for each beach segment (chapter 4). Also, we are able to observe the spatial variation of WTP for moving away from the status quo across four adjacent beach segments (chapter 5).

1.4.4 Summary of chapters

Chapter 2

This chapter aims at assessing tourists' preference of coastal erosion management program in Hội An and their willingness to pay for each attributes. Moreover, the chapter explores tourist' preference heterogeneity explained by trip-related variables such as beach use, trip duration, and respondents' knowledge of coastal erosion.

Using the MIXL model, the chapter finds that tourists value a wider and more publicly accessible beach that is protected by structures. They are willing to pay for a pristine beach covered by trees. In addition, preferences of domestic and international tourists are addressed. Vietnamese tourists support a beach with hard protection construction and having both restaurant and trees, while foreign tourists incline toward both soft and hard protection structures and value the presence of trees on a beach, either with a restaurant or without.

Estimation results from a Latent Class Model (LCM) show that there are four subgroups of tourists which are characterized as "whatever access", "tree selection", "current beach inclination" and "tax devoted". Group dominated by domestic tourists tends to be indifferent to a more public beach and supports only hard protection structures, while short-time foreign visitors who mostly visit the beach, accounting for half of the sample, prefer a pristine beach having only tree as recreational feature. On the other hand, short-time foreign tourists who visit the beach and acknowledge the coastal erosion problem in Hội An are found to accept the current situation of the beach but also express a preference towards the beach protected by any type of structures and having any type of facilities.

The finding in this chapter supports several policy implications. Firstly, expansion of beach area and beach access should be promoted in a coastal erosion management program. Secondly, a strategy where beach nourishment is accompanied with hard protection structures is proposed as an effective coastal erosion management program on preventing serious erosion as in Hội An. Thirdly, a plantation of coastal tree (coconuts tree in the case of Hội An) is an economical beach management strategy that can gain welfare for foreign tourists. Finally, tourists can contribute on financing coastal erosion management program. Tourists are averagely willing to pay \$13.295 per person for moving away from status quo and a total up to \$42.5m with 3.2 million tourists visiting Hội An in 2017.

Chapter 3

The chapter explores local residents' preference to a coastal erosion management program in Hội An and how experience, knowledge of coastal erosion and level of education affect their choice behavior and choice randomness.

Applying Generalised Multinomial Logit (G-MNL) model, the chapter finds that residents value a wider beach allowing higher percentage of public access. Moreover, the results indicate residents' preference to a beach protected by visible structures such as groynes and stair revetment. In terms of recreational facilities, residents incline to a beach having both restaurants and trees. Estimation from G-MNL model points out strong scale heterogeneity across respondents, reflecting a high level of choice randomness among residents. We incorporate individual-specific characteristics including level of education, stated certainty of choice, acknowledgment of coastal erosion problem in Hội An to vary with scale mean. The estimation points out that higher level of education and stated certainty in their choice question makes respondents more consistent in their choice decisions. Moreover, those who think that coastal erosion causes problem in Hội An exhibit a higher level of choice randomness. With only 18.8% of sample having college degree or above, we conjecture that the task complexity of the DCE might cause a challenge for most residents in Hội An to analyze and interpret the choice task. In addition, given that a majority of sample (94%) acknowledges the problem of coastal erosion in Hội An, this makes their choice less driven by the interpretation of the DCE.

Aiming at exploring observed preference heterogeneity of Hội An residents, we use MNL model with interactions between attributes and variables concerning their experience, their awareness of coastal erosion and their economic activity if it is related to tourism. Estimated results show that being highly impacted by erosion and acknowledgement of erosion leads respondents tend to support protective structures than others. Furthermore, residents who work in the tourism related activity place higher value on a beach having both restaurants and trees, and protected by the structures providing visitors with better access to the sea.

Using WTP estimates from a WTP-space model, the chapter provides two policy implications. Firstly, local residents are willing to contribute to funding coastal erosion management program in Hội An. Second, a mixture of beach nourishment and construction of protection structures rather than only beach nourishment is preferred by residents.

Chapter 4

The chapter has two objectives. First, the paper provides an in-depth comparison between tourists' and residents' preferences to a coastal erosion management program. Second, the difference of the valuation across beach segments is addressed by using a setting of split-sample.

Using an error component mixed logit model, we take into account (1) differences in preferences, (2) taste heterogeneity, and (3) differences in the uncertainty of choice behaviour between two groups. The chapter estimates two models including the pooled model that assumes similar preference between two groups, and the pooled model with group-specific preference for tourists and residents. Confidence intervals for WTP are obtained using a bootstrap technique. We first capture the preference of respondents for a coastal erosion management program in the whole Hội An beach, considering the entire beach as an homogeneous environmental good. Second, since this entire beach can be divided in four segments based on the erosion rate and coastal erosion protection structures, we use split-sample to value coastal erosion management program in each of four beach segments. We then estimate the four split-samples in order to investigate how the differences between the four beach segments are perceived by respondents and address the spatial heterogeneity of Hội An beach's segments.

This chapter shows that both groups prefer a wide public beach. In terms of beach protection against erosion, both groups have a preference for a protected beach, but tourists differ from residents as they place a higher value on the construction of hard protection structures, while residents incline to groynes, which preserve the accessibility of the sea. Concerning recreational facilities, there are some discrepancies between two groups of respondents. Residents are only in favour of a beach having both restaurants and trees, whereas tourists place higher value on a beach with only trees. The results point out a higher noise in utility in group of residents, which could be explained by the task complexity and the acknowledge of the coastal erosion problem in Hội An. Finally, our results suggest a differentiation of preference towards coastal erosion management program across four beach segments, which reflects that the current state of beach segments in Hội An is perceived differently by respondents.

Our findings support some policy implications. Firstly, both tourists and residents are willing to pay for a coastal erosion management program in Hội An. Secondly, tourists' WTP for coastal erosion management programs is sufficient to fund the required budget. Thirdly, it again confirms the results found in previous chapters that an efficient coastal management policy strategy could be to combine beach nourishment with the construction of a protective structure. Fourth, trees should be planted along the beach, and different types of facilities should be applied across beach segments. Fifth, keeping public at least some parts of the beach in Hội An is necessary, and private coastal hotels and resorts should be encouraged to contribute funding for a coastal erosion management program. And finally, the development of intra-site management where different management programs are applied to different beach segments is proposed.

Chapter 5

The chapter brings about the multi-directional spatial pattern of valuation on coastal erosion management program and spatial variation of valuation across four adjacent beach segments. Moreover, it explores how respondents' characteristics affect the spatial patterns of valuation.

The chapter uses the MIXL model as the baseline specification and incorporates the multi-directional distance decay function into the utility of status quo. By that, the variation of respondents' preference for implementation of coastal erosion management program. i.e. moving away from status quo, can be captured. In addition, the chapter provides a straightforward illustration of the estimation result by deriving a map on spatial distribution of WTP for implementing coastal erosion management program. The interpolation techniques and GIS data are used to get a smoothed representation of map. Moreover, in order to capture the heterogeneity of spatial preferences towards coastal erosion management programs caused by respondents' characteristics, a dummy variable representing respondents' characteristic is crossed with the distance decay function.

The chapters have three main results. First, the chapter finds that resident's preferences for coastal erosion management programs follow spatial patterns. Moreover, spatial patterns of preferences for coastal erosion management programs are better represented using a multi-directional distance decay function compared to a unidirectional one. In other words, people living far away from the valued beach, especially in the southeast direction, have higher utility for implementation of a coastal erosion management program. Although the finding of a reverse distance decay effect is not usual in existing literature, it might reflect a fact that beach in Hội An is considered as an iconic asset that receives valuation of the whole sample across the city. Moreover, it should be noted that the southeast area of the city is where the river goes through and the river-mouth is located. The higher exposure to climate change and natural disaster such as flooding and river erosion might be a motivation for residents in this area to place higher WTP for protecting the beach from erosion than other stable parts. Second, the chapter points out a variation of spatial patterns of respondent's preferences for coastal erosion management programs according the beach segment considered. Residents living in a given coastal segment tend to have higher WTP for management programs in adjacent segments than the one they live, the trend is even stronger for those who locate in the southern coastline. This result supports an evidence on spillover benefit that a coastal erosion management generates across adjacent coastal communities. Lastly, the chapter finds no significant difference in distance effect between beach users and non-users, but there is a heterogeneity in distance effect between high-income and low-income residents, and those who have more children and others.

The estimation results support some policy issues in designing appropriate incentives to fund coastal erosion management programs. First, the city could raise fund from local residents to implement the coastal erosion management program. Second, a different tax scheme should be applied for different beach segments. Third, a delineation of tax rates based on household income or the value of housing is more feasible to reach the acceptable of Hội An residents on implementation of coastal erosion management program.

Chapter 2

Tourists' preferences and Willingness to Pay for differing coastal erosion prevention programs: A choice experiment on domestic and foreign visitors to Hội An, a UNESCO World Heritage Site in Vietnam[1]

[1]This chapter has been recently submitted.

2.1 Introduction

Coastal erosion has caused significant damage to properties, businesses, and negatively affected the livelihood of billions people globally. Due to climate change, coastal erosion is expected to accelerate requiring more effective prevention measures (Vousdoukas et al., 2020). Effective erosion prevention measures, however, require substantial capital investment which typically exceeds the budget of local and central governments, especially in developing countries. The literature shows that tourists are willing to pay significant amounts for prevention programs (Schuhmann et al., 2019; Marzetti et al., 2016). Hence, financial contributions of tourists can play a crucial part in implementing effective coastal erosion prevention programs in those areas dominated by tourism activities. However, existing empirical literature on WTP for coastal erosion prevention measures focus only on areas in European and American countries. In fact, empirical estimates for the WTP of tourists for coastal erosion prevention in Asian developing countries such as Vietnam are very limited. This paper aims to fill in this gap by conducting a DCE to estimate the WTP of domestic and international tourists visiting Hội An, a UNESCO World Heritage site in Vietnam for differing measures of coastal erosion prevention.

Vietnam has 3260 km of coastline but most of the country's coastal provinces are facing increasing erosion due to climate change (GFDRR, 2015). In particular, Hội An City, a UNESCO World Heritage (WH) Site, has experienced rapid erosion - an average of 12 meters per year (Viet et al., 2015). Coastal erosion is estimated to cause a tourism revenue loss for Hội An of about $29 million by 2040 (Thinh et al., 2019). As an essential economic activity of Hội An, tourism accounts for around 60% of the city's total income with 3.2 million tourists visiting the city in 2017. Hence, Hội An City is in an urgent need of immediate and effective measures to prevent further erosion.

Addressing the problem of coastal erosion requires large upfront and an ongoing supply of capital. However, Hội An City has been facing financial shortages (UN-Habitat, 2014). For example, the cost of building and maintaining an infrastructure system for

20 years and which employs groynes to protect 60 meter of beach width is about $76 million (Fila et al., 2016). But the city can only mobilise $46.2 million to build an embankment in some parts of the beach. While city residents are willing to contribute to this funding Nguyen et al. (2021), the literature suggests that tourists can make a significant contribution to fill this funding gap (Barrio and Loureiro, 2018; Casey and Schuhmann, 2019). Empirical evidence for the WTP for coastal erosion prevention by tourists in Vietnam, however, has been lacking. Thus, this estimate of WTP is crucial for policy planning. Additionally, Hội An's authorities have been considering several options for erosion prevention measures which are classified into two main groups: hard protection constructions of groynes and stair revetments and soft prevention measure such as sandbags. These measures have differing impacts on tourists' experiences; hence the authorities also need more empirical information on the preferences of tourists regarding these erosion prevention measures.

Our research aims to provide empirical evidence to address two important questions: how much are tourists willing to pay for coastal erosion prevention measures and what are differences in their willingness to pay for differing erosion prevention measures? To achieve these aims, we conducted a DCE with the assistance of 200 tourists to capture direct and indirect use values of the beach and to reveal the level of preference heterogeneity across four latent sub-groups of tourists in the sample. Our empirical results provide several important policy implications. First, there exists a preference heterogeneity across domestic and foreign tourists with respect to the hard protection and soft prevention measures. Similarly, there exists a preference heterogeneity between domestic and foreign tourists regarding the facilities on the beach. One notable empirical finding which contrasts with other studies is that tourists support visible protection structures even though these hard measures have negative impacts on the natural aesthetics of the beach. Most importantly, our results show that the WTP estimated in this study is much higher for tourists than for local residents as reported in the literature. Remarkably, tourists coming to Hội An could contribute up to $42.5 million per year for further measures to prevent coastal erosion. This contribution is sufficient to fill the budget shortfall that local authorities face in implementing their planned prevention programs.

The paper is organized as follows. The literature review is presented in Section 2.2. Section 2.3 introduces the case study. Materials and methodology are described in Section 2.4. Estimation results are presented in Section 2.5 and Section 2.6 provides a discussion of the findings and concludes.

2.2 Literature Review

Coastal management was traditionally considered to be within the responsibility of local residents and authorities. Hence, many studies on the valuation placed on coastal resources had focused on the preferences of local residents' WTP for the management of coastal environmental and recreational attributes - which was shown to be highly significant (Ardeshiri et al., 2019; Halkos and Matsiori, 2018; Huang et al., 2007; Matthews et al., 2017b; Remoundou et al., 2015). However, in areas where the local population is not numerous or the residents' WTP is low, the estimated welfare gains can be outweighed by the cost of a coastal management policy. For such areas with high levels of tourist activity, it is proposed that an alternative funding solution be sourced from tourists' contributions. Therefore, understanding tourists' preferences and valuation of tourist sites is of paramount importance for the successful design and implementation of optimal coastal management strategies in areas with high tourism activity (Seekamp et al., 2019; Barrio and Loureiro, 2018).

There is a rich literature on tourists' preferences for a variety of coastal attributes. Among these studies, beach dimensions and access are the most influential factors on the estimation of tourists' WTP for coastal management programs. Whitehead et al. (2008) estimated that, while the annual aggregate benefits of southern North Carolina beach trips was about $791 million, the annual recreation benefits of improved beach access and increased width is about $325 million and $62 million, respectively. Oh et al. (2008) examined tourists' preference for public beach access in South Carolina and found that tourists were willing to pay an extra $6.60 per day for additional beach access points and parking – a potential contribution of $93 million per year.

Schuhmann et al. (2016) examined visitors' perceptions of other environmental and quality attributes such as lodging type, distance, and the amount of litter on the beach. The author found that visitors need to be compensated approximately $45.00 for each additional unit of beach litter present and approximately $56 per additional minute of walking distance to the beach. Schuhmann et al. (2019) examined tourists' WTP for a marine conservation fee and found the mean WTP to range from $36 to $52 per visit. Overall, the literature suggests that there is a positive and significant WTP from tourists for a variety of coastal attributes which could contribute to coastal management funds.

Several studies indicate that tourists generally have higher WTP than residents, suggesting that sourcing funding from tourists for coastal management is a viable and more sustainable strategy, especially in areas with high levels of tourism (Hynes et al., 2013; Shan and Li, 2020). Oh et al. (2010) conducted a study in South Carolina using a DCE to compare tourists and residents' preferences for public beach access and related amenities. The authors found that tourists were willing to pay $12.80 and $15.60 to acquire one and two more main beach access points respectively, whereas residents' implicit prices were only $7.90 and $9.40 for access points, respectively. Dixon et al. (2012) conducting a similar study in South Carolina concluded that tourists had significantly higher WTP for additional public beach access. Christie et al. (2015) uncovered the preferences for marine and coastal ecosystem services in the Grenadine's Marine Protected Area finding that tourists had significantly higher WTP than local residents. Christie et al. (2015) estimated that the total WTP of all tourists was between $3.63-5.59 million, in comparison to only $0.05-1.75 million for residents. This is significant given there were more tourists than local residents in this area.

Another important finding reported in the literature is that preferences differ among groups of tourists (Barrio and Loureiro, 2018). Beharry-Borg and Scarpa (2010) compared the preferences between snorkelers and non-snorkelers and concluded that it is feasible to consider a differentiated pricing policy for different activities undertaken by beach recreationists. Some studies have also been conducted in high tourism and developing areas such as the Caribbean. For example, Hess and Beharry-Borg (2012) and Schuhmann et al. (2019) found that foreign tourists were generally willing to pay more than domestic tourists for conservation efforts.

While other studies focus on coastal management for recreational activities, another line of literature focuses on valuation of coastal management to prevent beach erosion. The literature shows that WTP to protect coastlines against erosion differs across different areas. In developed countries, WTP by beach visitors in North Carolina (US) for alternative protection policies including shoreline retreat, nourishment and armouring are $22.2, $7.91 and $0.09 per household per year, respectively (Landry et al., 2020). Daily mean WTP of beach users for coastal erosion defence in Mediterranean beaches in Greece, Italy, and France are about €0.5-1.49 (Koutrakis et al., 2011; Marzetti et al., 2016). The annual WTP for dune restoration and seawall in Mercury Bay in New Zealand are estimated to be around $88 and $50 respectively (Matthews et al., 2017a). In developing countries, WTP per year per visitor for a coastal erosion protection program in Nam Rin beach and Cha-am beach in Thailand is $24.8 and $102.96 (Saengsupavanich et al., 2008b; Saengsupavanich, 2019) and WTP in Tunisia is €5.09 per year per resident and €5.02 per tourist per visit (Dribek and Voltaire, 2017).

The valuation of World Heritage (WH) sites has received increasing attention in recent years. Wuepper (2017) points out that WH status for a national park in northeast Germany increases WTP to go to the park by €4.73 per person. In this way, tourists can significantly contribute to the funding of heritage site management (Chen and Chen, 2012; Loyola et al., 2021).

In Vietnam, the valuation for coastal management has a focus on the preferences of local populations. Local residents Cat Ba, a northern island in Vietnam, are found to be willing to pay $8.64 for mangrove restoration to mitigate storm impacts (Pham et al., 2018a). Similarly, households in Thi Nai lagoon in Quy Nhon, a central coastal province, are willing to pay $6.52 for mangrove restoration (Tuan et al., 2014). Borger et al. (2021) have reported that the local residents of Nha Trang, a coastal city, are willing to pay more for limiting plastic pollution than for the improvement of water quality and protection of coral reefs.

To sum up, in the growing literature on the WTP for beach management and ecosystem services, there are few studies on tourists' valuation of coastal erosion. Our overall aim, then, is to provide Hội An City local authorities with empirical evidence to assist them in policy design and implementation of coastal erosion preventative measures. This study also contributes to the literature in terms of revealing tourists' preference in relation to a touristic site with WH status in developing countries.

2.3 Tourism and coastal erosion in Hội An

Hội An is located along the coastline in the central part of Vietnam. It has a population of around 150,000 people. Its ancient town, considered as "an exceptionally well-preserved example of a traditional Asian trading port", has received UNESCO World Heritage Site status since 1999 [2]. The City has preserved its original form and heritage, including wooden architecture and the integration of indigenous and foreign cultures (Bui et al., 2020). Cua Dai beach, which is part of Hội An, is considered one of the most beautiful beaches in Vietnam. Since being listed as World Heritage Site, the number of tourists visiting Hội An increased significantly from 160,000 visitors in 1999 to nearly 3.2 million visitors in 2017. Tourism, which accounts for about 60% of the city's total municipal revenue.

In recent years, serious erosion has damaged several parts of the coastline in Hội An, especially Cua Dai beach, to the extent that sand is no longer present in some areas and buildings adjacent to its shores are susceptible to destruction.Viet et al. (2015) find that Cua Dai beach is under severe erosion particularly around the Thu Bon river mouth, where the shoreline has retreated by between 200 and 500m from 2004 to 2014. Several research projects have been conducted to identify the mechanisms leading to coastal erosion in Hội An (Fila et al., 2016; Viet et al., 2015). According to these studies, natural variation, environmental changes such as sea level rise, increased storm

[2] https://whc.unesco.org/en/list/948

frequency and anthropogenic causes such as sand mining and dam construction are leading causes of increased erosion.

Coastal erosion has two notable economic impacts. Firstly, this causes significant damage to properties and assets including hotels, resorts, and restaurants. Secondly, there is the danger that coastal erosion can lead to severe degradation or complete destruction of attractive landmarks. This would cause a severe negative impact on the sustainability of the local tourism sector which is the main economic sector for local people. It is estimated that total tourism revenue losses due to coastal erosion in 2020 was $14 million and increased to $29 millions by 2040 (Thinh et al., 2019)[3].

To minimize the risk of erosion of Cua Dai beach, Hội An's authorities have implemented a variety of erosion management techniques including groynes, stair revetments and concrete revetments (which are considered as hard protection measures) and sandbags (considered as a soft protection measure) at various parts of the coastline. The local government plans to expand these programs but is faced with tight budget constraints. Mobilising financial contributions from domestic and international tourists has been proposed although debate on the choices of coastal erosion prevention techniques continues at the local governmental level. There are concerns that financial contributions by tourists are not sustainable as payments imposed on tourists could have a negative impact on the level of tourist arrivals. In addition, 'hard' measures could have negative impacts on the experience and satisfaction of tourists. To assist the policy debate, there is clearly a need for empirical evidence on tourists' preferences and valuation. The main objective of this paper, then, is to explore Hội An's visitors' preferences for different erosion management options, and thereby contribute to the selection of an efficient coastal erosion management strategy and funding.

[3]In this study, $ refers to United States Dollars

2.4 Materials and methodology

2.4.1 Discrete Choice Experiment

Attributes.

Our study focuses on both non-consumptive direct use values and indirect use values of a coastal protection policy that includes regulations (e.g. defence methods) and cultural services (e.g. beach recreation). This leads to the selection of five attributes: (1) protection structures, (2) average beach width, (3) public access, (4) recreational offers and facilities, and (5) payment vehicle. Table 5.1 presents descriptions and levels for the attributes.

Table 2.1: Description of the attributes and levels for a coastal erosion program

Names	Descriptions	Levels
Protection structures	Type of protection structures applied to protect the coastline from erosion	No structure, Sandbags, Stair revetment, Concrete revetment, Groynes
Beach width (in meters)	The average width of the beach which can be increased by beach nourishment.	0, 25, 50, 75, 100, or 150
Public Access (%)	Percentage of the beach that gives free access to all visitors	0, 25, 50, 75, or 100
Recreational offers and facilities	Type of recreational offers and facilities that are available in the beach	Nothing, Trees, Restaurants, Restaurants and trees
Payment vehicles	Tourist tax per tourist per visit to Hội An for coastal erosion management.	$ 0, 2, 4, 6, 8, 10, or 15

Split Sample. Beaches in Hội An have varying characteristics among different parts, therefore we divided the beach into four coastal segments based on erosion rates (see Figure 2.1). Description of each coastal segment is presented in Table 2.2.

Figure 2.1: The division of four coastal segments

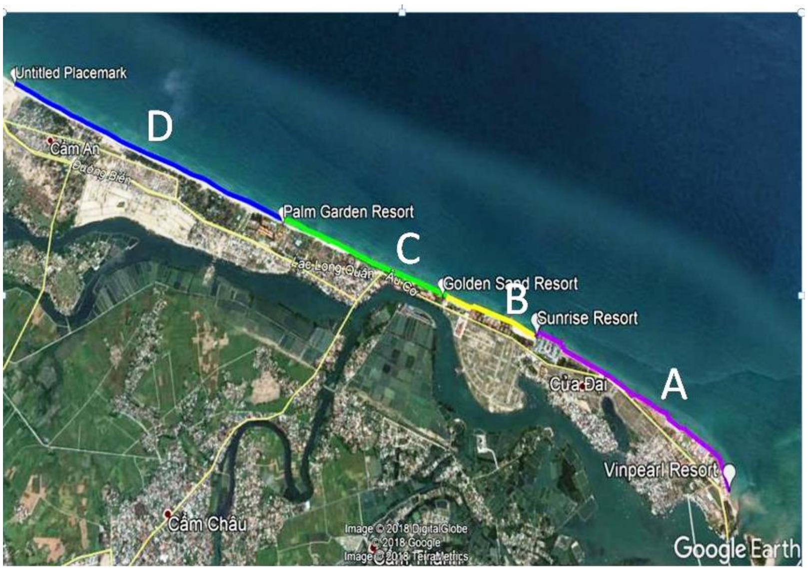


Table 2.2: Description of Coastal Segments

Characteristic	Beach A	Beach B	Beach C	Beach D
Erosion Situation	Severely eroded and decreased about 70 to 190 meters of beach width	Decreased about 60 to 120 meters of beach width	Decreased about 40 meter of beach width	Unchanged in the past 13 years
Current Protection Construction	Concrete Revetment	Nothing	Sandbags	Nothing
Current Beach Width (meters)	0	25	25	50
Current Public Access (%)	50	50	50	100
Current Recreational Facilities	Nothing	Trees	Trees and Restaurants	Trees and Restaurants

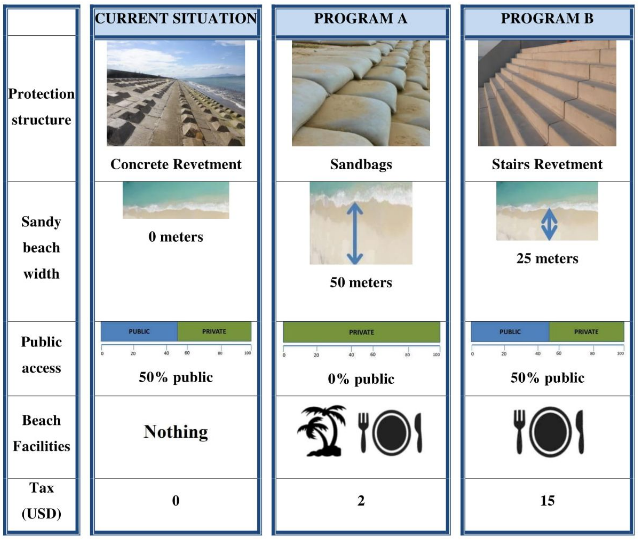
Choice Experiment Design. The design of a DCE complies with the guidelines provided by (Johnston et al., 2017). A multinomial format with two alternatives and a current situation is applied to a choice task. Attributes and levels are presented with both text and images, which support the understanding of and participation of respondents in a choice task (Balcombe et al., 2015; Louviere et al., 2000) (see Figure 2.2 for an example of a choice task). A video introduces the current state of the coastal erosion problem in Hội An, its causes and impacts, allowing respondents to have a clearer view of the baseline and how changes of the baseline might benefit them. More dynamic visualization techniques have been found to reduce choice errors and improve respondents' engagement when compared to the use of static images (Matthews et al., 2017b).

To deal with hypothetical bias, a "cheap talk" and "self-report certainty" questions are mentioned before and after the choice task respectively, as suggested by Johnston et al. (2017) and Ready et al. (2010). Protest answers are recognized through follow-up questions about their reasons of selecting the status quo and their stance towards paying a tax to reduce coastal erosion in Hội An.

The questionnaire consists of four parts. The first part deals with information relating to tourists' visit to Hội An. The second part is the choice experiment section. Socioeconomic information is delivered in the third part. The final part addresses tourists' personal economic preferences.

The experimental design followed the D-efficient design (Clark et al., 2014) and was conducted in *Stata*. There are 3 versions of choice tasks for each beach part, each of which consists of 6 choice sets. Respondents are randomly assigned to a version of one of four beach parts. We take into account the unrealistic, irrelevant and dominant alternatives as suggested by Cherchi and Hensher (2015) and Terawaki et al. (2003); however, results from the pilot survey show no evidence of the dominance of alternatives and no noticeable sign of irrelevant combinations of attribute levels.

Figure 2.2: Example of choice set in the DCE



Survey Model and Sampling. The survey is implemented with a face-to-face interview. The questionnaire is converted into an interactive application and respondents are asked to make choices using a tablet. Convenient sampling is used, in which tourists are interviewed in main tourist attraction sites. The final sample consists of 200 respondents. The survey was conducted in July 2018. The visitors were intercepted at random at the main tourist attraction sites of Hội An - including beaches and the Old Town - to ensure sampling representativeness of the tourist population.

2.4.2 Sample description

Table 2.3 describes the characteristics of the 200 tourists who participated in the survey. About 40% and 60% of the sample are domestic visitors and foreign visitors, respectively. This figure shows a larger proportion of domestic to foreign tourists in Hội An compared to the official figures observed for the first half of 2018 [4]. They show that roughly 25% of visitors were domestic and 75% foreign. The second and third largest groups of visitors are European (29.5%) and foreign Asian (12%), respectively. Foreign Asian visitors from China, Korea, Japan, and Hong Kong had the highest rate of survey interview

[4] Vietnam National Administration of Tourism - http://vietnamtourism.gov.vn/index.php/items/26727

refusal than any other visitor groups. The ages of respondents ranged between 16 and 66 years old, with a slightly larger portion of male (56.5%) to female (43.5%) respondents in the sample. 94% of respondents have at least a college or university-level degree. Visitors stay, on average, 3.4 days in Hội An and over two-thirds of them planned to visit beaches. For those who did not plan a beach visit during their stay, the main reasons were lack of time (59.3%) and having alternative points of interests (18.6%). For those who visited the beach, they mainly did so for relaxing and sunbathing (41.8%), enjoying the landscape (23.4%) and swimming (15.6%). Most tourists acknowledged the existence of coastal erosion problems.

Table 2.3: Sample description

	Category	
Nationality	Total	200 (100%)
	Vietnamese	81 (40%)
	European	59 (29.5%)
	North American	11 (5.5%)
	South American	4 (2%)
	Australian and New Zealander	16 (8%)
	African	5 (2.5%)
	Asian, non-Vietnamese	24 (12%)
Trip information		
Duration in Hội An (days)	Min	1
	Max	5
	Mean	3.4
Plan of visiting beach (%)	Yes	70.5
	No	23.5
	Don't know	6
Reason for not going to beach (%)	Don't know there is a beach	3.4
	Don't have time	59.3
	Other interesting things to do in Hội An	18.6
	More beautiful beaches in Vietnam	8.5
	Other reasons	10.2
Purpose of visiting beach (%)	Swimming	15.6
	Relaxing and Sunbathing	41.8
	Enjoying landscape	23.4
	Enjoying seafood, restaurant, bars	4.3
	Other purposes	14.9
Acknowledge of coastal erosion problem in Hội An (%)	Yes	60.5
	No	39.5
Demographic Information		
Age	Min	16
	Max	66
	Mean	29.9
Gender(%)	Female	43.5
	Male	56.5
Education	Highschool graduate	5.5
	College or University	74.5
	Post-graduate	19.5
	No answer	0.5

2.4.3 Methodology

The discrete choice modelling.

The choice experiment method is used to account for tourists' preference and welfare on the coastal erosion protection programs. The choice experiment is a non-market valuation method that has become increasingly popular over the past decade for the valuation of public goods and environmental policies. The logit model is one of the most widely used discrete choice model (Train, 2000) and is completely analysed by the Random Utility Model (RUM) (McFadden, 1974). A respondent, i, faces a choice among J alternatives. The respondent obtains a certain level of utility U_{ij} from alternative j, with $j = 1, ..., J$. The respondent chooses the alternative that provides the greatest utility, i.e. chooses alternative k if and only if $U_{ik} \geq U_{ij}$, for all $j \neq k$. Utility is decomposed $U_{ij} = V(x_{ij}|\beta_n) + \epsilon_{ij}$ where $V(x_{ij}$ is the observed part and ϵ_{ij} is an unobserved part. The observed part of utility is usually specified to be a linear function in parameters $V_{ij} = \beta_i X_{ij}$ where X_{ij} denotes a K-vector of observed attributes of alternative j. According to McFadden (1974), the ϵ_{ij} is assumed to be independently and identically distributed and the parameter β_i is homogeneous across respondents.i.e $\beta_i = \beta$. These assumptions form the classic multinomial logit model (MNL):

$$U_{ij} = \beta X_{ij} + \epsilon_{ij} \tag{2.1}$$

Mixed Logit and Latent Class Model.

A flexible model developed from MNL and is able to account for heterogeneity of preferences is the mixed logit model (MXL). The most popular form is based on random coefficients (Train, 2009). The utility of respondent i from choosing alternative j can be rewritten as:

$$U_{ij} = \beta_i X_{ij} + \epsilon_{ij} \tag{2.2}$$

where β_i is a vector of parameters for respondent i and is assumed to follow a continuous density.

Preference heterogeneity can be also accounted for by the Latent Class Model (LCM) which uses a discrete distribution over unobservable, endogenous (latent) classes of respondents. Preferences are assumed to be homogeneous within each class but are allowed to differ across classes .i.e. respondents i belongs to class q with probability w_{iq}:

$$\beta_i = \beta_q \text{ with probability } w_{iq} \text{ for q = 1, . . . , Q,}$$

The population is thus represented as a finite number of segments, or classes. The number of the class is endogenously determined by the data, while membership to a class depends probabilistically on the respondents' observable socio-economic or attitudinal and behavioral characteristics. Utility of a respondent i who belongs to class q derives from alternative j is written by

$$U_{ij|q} = \beta_q X_{ij} + \epsilon_{ijs}$$

Heterogeneity implies each class has its own utility parameter vector $\beta_q \neq \beta_k$.

We use MNL model and the LCM for this study. In these models, the parameter estimate of the specific attribute and the price attribute can be interpreted as the marginal utility of that attribute and the marginal utility of the monetary unit, respectively. Dividing these two parameters can result in the estimation of the WTP parameters which are the marginal values when moving from the initial level of the attributed to another level. Therefore, the marginal WTP is given by

$$WTP_{attribute} = \frac{\beta_{attribute}}{\beta_{monetary}} \tag{2.3}$$

2.5 Estimation results

2.5.1 Preference of tourists towards coastal erosion prevention program

The models are estimated in R by the *gmnl* package (Sarrias and Daziano, 2017). The mixed logit models are estimated with 500 Halton draws. All parameters are assumed to follow a normal distribution, except for the tax parameter. The alternative specific constant (ASC) is included in the estimated model to capture the status quo bias (Scarpa et al., 2005) and is assigned a value 1 for the current situation and 0 otherwise. The continuous variables Tax, Width and Access refer to the tax, width, access attributes. The facilities and protection structure attributes are dummy coded and are equal to 0 when there is no facility or protection structure. Thus:

$$
\begin{aligned}
U_{ijt} = \beta_{1i} * Protection\,Sandbags + \beta_{2i} * Protection\,ConcreteRevetment \\
+\beta_{3i} * Protection\,StairRevetment + \beta_{4i} * Protection\,Groynes + \\
\beta_{5i} * Facility\,RestaurantTree + \beta_{6i} * Facility\,Tree + \beta_{7i} Facility\,Restaurant \\
+\beta_{8i} * Width + \beta_{9i} * Access + \beta_{10i} * Tax + \beta_{11i} * ASC + \epsilon_{ijt}
\end{aligned}
\tag{2.4}
$$

Table 3.4 displays the estimation results of the MIXL for different groups of tourists (Equation 4.1). The positive sign for Width and Access shows that tourists are inclined to prefer a wider and more public beach. However, tourists are averse to the current situation of the beach with a negative sign for ASC. Both these variables are statistically significant. These empirical findings are consistent with previous studies on coastal management (Banerjee et al., 2018; Landry et al., 2003; Oh et al., 2008; Remoundou et al., 2015). With respect to protection measures, it is surprising to note that tourists support all types of hard protection structures relative to having no structures. Among all hard and soft measures, concrete revetments are the most preferred measures. With regard to beach facilities, the estimation results show the tourists' preference for trees on the beach. These preferences slightly differ from that of Hội An residents which only favour a beach protected by groynes and having both restaurants and trees.

Columns 4 and 5 present the results estimated using data for two groups of domestic and foreign tourists. Consistently, both subgroups of tourists place a higher value on a wider and publicly accessible beach. While foreigners prefer all type of protection structures, domestic tourists favour only hard constructions. Moreover, groynes and concrete revetments are the two options that receive higher a value from both groups of tourists. The significantly positive coefficient for "Restaurant-Tree" for the group of domestic tourists suggests that domestic tourists are inclined to beaches with full facilities having both restaurants and trees, while foreign tourists prefer a pristine beach with trees, either only trees or both trees and restaurants.

Table 2.4: Mixed logit model estimation

	MIXL All Tourists	MIXL Domestic Tourists	MIXL Foreign Tourists
Mean of random parameters			
Facility:Restaurant	-0.057(0.183)	-0.046(0.295)	-0.125(0.232)
Facility:Restaurant-Tree	0.583(0.16)***	0.48(0.255)*	0.575(0.194)***
Facility:Tree	0.634(0.165)***	0.229(0.26)	0.778(0.201)***
Protection:Groynes	0.915(0.188)***	1.235(0.339)***	0.664(0.212)***
Protection:Concrete Revetment	0.99(0.183)***	1.318(0.322)***	0.746(0.213)***
Protection:Stair Revetment	0.923(0.205)***	1.56(0.347)***	0.412(0.238)*
Protection:Sandbags	0.522(0.191)***	0.514(0.322)	0.495(0.224)**
Width	0.005(0.001)***	0.004(0.002)*	0.006(0.001)***
Access	0.02(0.003)***	0.01(0.004)***	0.024(0.003)***
Tax	-0.069(0.014)***	-0.11(0.025)***	-0.044(0.016)***
ASC	-0.921(0.228)***	-1.705(0.472)***	-0.682(0.261)***
Standard Deviation of random parameters			
Facility:Restaurant	0.888(0.277)***	0.984(0.404)**	0.8(0.353)**
Facility:Restaurant-Tree	0.611(0.283)**	0.524(0.598)	0.405(0.5)
Facility:Tree	0.68(0.266)**	0.178(0.855)	0.462(0.48)
Protection:Groynes	1.158(0.287)***	1.592(0.47)***	0.672(0.473)
Protection:Concrete Revetment	0.515(0.378)	0.621(0.613)	0.094(0.971)
Protection:Stair Revetment	0.608(0.358)*	0.619(0.727)	0.098(1.125)
Protection:Sandbags	1.078(0.269)***	1.168(0.451)***	0.848(0.345)**
Width	0.001(0.005)	0.003(0.004)	0.002(0.006)
Access	0.019(0.003)***	0.019(0.005)***	0.015(0.004)***
ASC	1.89(0.229)***	2.539(0.482)***	1.587(0.238)***
Log Likelihood	-1101.95	-430.10	-652.09
AIC	2245.90	902.20	1346.18
BIC	2352.79	990.11	1442.16

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

2.5.2 Latent class estimation

To capture tourist preference heterogeneity, we conducted subgroup analysis using a LCM. The class membership includes a set of socio-demographic, trip-related variables. "Older" refers to tourists whose age is above the average age of the sample (over 30 years old), “Longer stay” refers to tourists who stay longer than the average duration (more than 2 days), and “Acknowledge” refers to tourists who think that Hội An is facing problems due to coastal erosion.

The optimal number of classes is decided based on information criteria statistics and the significance of parameters. Increasing the number of class will normally lead to the improvements of the log-likelihood and AIC. According to Andrews and Currim (2003), the Bozdogan AIC (AIC3) criteria is better than AIC and BIC in choosing the optimal number of classes. Models with four classes have a minimum AIC3 and AIC and the highest number of significant parameters, showing that this model is optimal for estimation. In terms of class assignment probability, the model normalizes coefficients of the first class to zero, leading to the point that describing class membership is related to this class (Boxall and Adamowicz, 2002).

Table 2.5: Model statistical criteria

Number of classes	Log likelihood	AIC	AIC3	BIC
1	-1201.42	2424.83	2435.83	2480.82
2	-1099.84	2255.68	2283.68	2398.21
3	-1084.26	2258.52	2303.52	2487.58
4	-1025.47	2174.95	2236.95	2490.53
5	-1011.29	2180.57	2259.57	2582.69
6	-984.73	2161.45	2257.45	2650.10

The estimation results show statistical evidence of preference heterogeneity of tourists for coastal erosion protection programs. The negative parameters of ASC in three classes 1, 2 and 4 indicate respondents’ preference for coastal erosion improvement programs at beaches. It is interesting to note that while preference for other attributes varies across classes, preference for a beach protected by hard structures including groynes and concrete revetments remains significant over all classes.

Class 1 makes up 12.2% of respondents. Members in this class are called as “Whatever access” since they are distinct to other groups in being indifferent to a more public beach. Moreover, they support a beach protected only by hard structures and not by soft structures including sandbags. In term of respondent characteristics, class 1 is generally characterized by respondents who are domestic tourists since the parameters

"Vietnamese visitor" are negative in all three other classes.

Class 2 represents half of the respondents (50.3%), and is dominated by foreign visitors who stay fewer than 2 days and plan to visit the beach in Hội An. This class is described as "Tree selection" since they show support for a beach with only trees as a feature. In addition, they are also in favour of a wider, more public beach.

While classes 1, 2, and 4 place a higher value on improvement options than maintaining the current beach situation, members of class 3 prefer the current situation of the beach, since the parameter for ASC is positive for class 3 while negative for the other classes. Moreover, it should be noted that foreign tourists who stay in Hoi but for a shorter duration than the average and who visit the beach and are aware of the coastal erosion problem of Hội An, have a higher probability of being in this class membership.

Class 4, representing a very small percentage of the sample, is described as "Tax devoted", is different from other classes in the sense that members are willing to pay a tax. Moreover, they have disutility for a beach with either only restaurants or only trees, and support more public accessibility. This class is comprised of foreign tourists who stay in Hội An for more than 2 days but do not visit the beach.

Table 2.6: Latent class model estimation

	Class 1 "Whatever access"	Class 2 "Tree selection "	Class 3 "Current beach inclined"	Class 4 "Tax devoted"
Utility Function				
Facility:Restaurant	-3.024(0.685)***	0.327(0.2)	1.259(0.443)***	-4.357(1.742)**
Facility:Restaurant-Tree	-0.513(0.418)	0.259(0.192)	2.049(0.39)***	0.416(1.172)
Facility:Tree	-1.075(0.439)**	0.41(0.195)**	2.428(0.436)***	-3.777(1.606)**
Protection:Groynes	1.114(0.505)**	0.83(0.19)***	0.924(0.389)**	4.189(1.549)***
Protection:Concrete Revetment	0.942(0.462)**	0.763(0.211)***	0.992(0.307)***	3.883(1.377)***
Protection:Stair Revetment	0.751(0.502)	0.636(0.224)***	1.333(0.389)***	2.115(1.3)
Protection:Sandbags	-0.856(0.5)*	0.496(0.206)**	1.833(0.316)***	-1.843(0.782)**
Width	0.006(0.004)	0.003(0.001)**	0.006(0.002)**	0.015(0.01)
Access	-0.002(0.005)	0.007(0.002)***	0.03(0.005)***	0.161(0.05)***
Tax	-0.431(0.091)***	0.01(0.015)	-0.123(0.027)***	0.344(0.133)***
ASC	-1.615(0.495)***	-1.571(0.292)***	0.584(0.306)*	-1.948(1.121)*
Class membership function				
Intercept		1.42(0.296)***	1.126(0.336)***	-13.1(51.344)
Beach Use		1.234(0.263)***	0.631(0.287)**	-1.883(0.488)***
Acknowledge		0.08(0.236)	0.744(0.258)***	13.895(51.337)
Longer Stay		-1.161(0.266)***	-0.545(0.309)*	2.402(0.955)**
Vietnamese Visitor		-0.769(0.26)***	-1.917(0.283)***	-2.972(0.522)***
Older		-0.067(0.239)	0.008(0.251)	-0.409(0.344)
Shares of Class(%)	12.2	50.3	37.5	<0.1

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

2.5.3 Willingness to Pay

Table 2.7 presents WTP estimates from the MLM estimation. Standard errors are computed using the delta method. The results indicate that tourists are generally willing to pay for the improvement program for the beach, at a WTP of $13.295. They are, on average, willing to pay for hard protection structures. Among these, their WTP for groynes, stair revetments, and concrete revetments are estimated to be $13.205, $13.326, and $14.293 respectively. Estimated WTP for soft prevention measure such as sandbag is much smaller (i.e. $7.539).

Columns 3 and 4 presents the results for domestic and foreign groups of tourists. The results show a higher WTP estimate for foreign tourists than domestic tourists. Domestic tourists are willing to pay $4.346 for a facilitated beach that has both restaurants and trees, while foreign tourists are willing to pay $13.067 and $17.695 for beaches with both trees and restaurants and with only trees, respectively. Domestic tourists are willing to pay for only hard protection structures, ranging from $11.192 (groynes) to $14.13 (stair revetments), whereas foreign tourists are willing to pay for both soft and hard structures, although soft structures receive a slightly lower WTP than hard ones.

Table 2.7: Willingness to Pay estimates

	All tourists	Domestic Tourists	Foreign Tourists
Facility:Restaurant	-0.828(2.627)	-0.417(2.662)	-2.851(5.252)
Facility:Restaurant-Tree	8.415(2.906)***	4.346(2.469)*	13.067(6.749)*
Facility:Tree	9.154(3.058)***	2.078(2.435)	17.695(8.101)**
Facility:Groynes	13.205(3.532)***	11.192(3.536)***	15.102(7)**
Protection:Stair Revetment	13.326(3.852)***	14.13(4.016)***	9.359(6.42)
Protection:Concrete Revetment	14.293(3.752)***	11.945(3.61)***	16.955(7.764)**
Protection:Sandbags	7.539(3.094)**	4.66(3.058)	11.248(6.577)*
Width	0.072(0.021)***	0.032(0.018)*	0.13(0.055)**
Access	0.285(0.062)***	0.095(0.037)**	0.535(0.196)***
ASC	-13.295(3.321)***	-15.451(4.339)***	-15.512(6.288)**

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

2.6 Conclusion

Hội An City, a World Heritage Site, has experienced increased coastal erosion for many years. The local government has been considering several differing measures to prevent further coastal erosion. However, the local authorities are faced with very tight governmental budgets for these erosion prevention programs. Proposals for obtaining financial contributions from both domestic and foreign tourists have been subject to public debate. There are two related questions involved in this policy proposal. First, how much are domestic and foreign tourists willing to pay for differing prevention measures? Second, what are the preferences of domestic and foreign tourists in relation to hard and soft measures of coastal prevention? The present paper provides the answers to these two questions by conducting a DCE involving 200 tourists who visited Hội An in July 2018.

Results show that tourists value a wider and more publicly accessible beach that are protected by hard construction structures. They are willing to pay for a pristine beach covered by trees. The result confirms preference heterogeneity between domestic and foreign tourists. Vietnamese tourists support hard protection construction and a beach that has both restaurants and trees, while foreign tourists are inclined toward both soft and hard protection structures and value the presence of trees on a beach, either with a restaurant or without. These results are robust across the four distinct groups of tourists estimated using the LCM.

While a positive WTP for protective actions is in line with prior literature, our study finds that tourists prefer hard protective structures over soft measures. This finding differs from the findings of Landry et al. (2020) and Oliveira and Pinto (2020) which report that soft management alternatives are considered more socially desirable. One possible explanation for this difference is due to the presence of negative externalities that reduce the economic benefits of a proposed strategy (Huang et al., 2007). Soft management alternatives with sandbags or no protection structure other than nourishment may not be effective at preventing serious erosion as in Hội An. The implication is supported by the finding from the LCM estimation that all four classes support a beach protected by hard structures.

Foreign tourists show a high level of interest in the presence of trees, and are willing to pay a considerable amount of \$17.695 to have trees on the beach. These findings provide important implications for Hội An's beach management authorities.

The direction of a beach management strategy should aim to improve beach areas and access, while more importantly focusing on coastal tree plantation programs to ensure the availability of green space at every beach. Because trees are much easier and economical to plant and manage than restaurants, planting more trees may generate significant welfare gains for foreign tourists and thus positively benefiting the local economy.

In term of coastal erosion protection, both domestic and foreign tourists show a positive WTP for groynes and concrete revetments while the foreign group preference is less clear for stair revetments as is the domestic group preference for sandbags. Moreover, the four classes in the LCM estimation clearly share similar support for groynes and concrete revetments. Hence, it is reasonable to say that groynes and concrete revetments are viable erosion management strategies that are supported by the majority of Hội An's tourists.

The payment vehicle is also an important aspect of designing an efficient coastal erosion program. Generally, people face a disutility from paying taxes and management fees due to various reasons, including awareness (Matthews et al., 2017b), trust (Jones et al., 2011) or the exposure to similar payment vehicles (Logar and den Bergh, 2014). The study by Schuhmann et al. (2019) suggests that in Caribbean beaches, domestic visitors are opposed to the payment vehicle of a marine conservation fee whereas foreign visitors are not. An alternative to some of the payment vehicle issues mentioned could be through a form of an indirect vehicle such as an accommodation tax or an integrated local tourism departments entrance ticket. However, more in-depth studies aimed at evaluating the effectiveness of payment vehicles are advised.

Given each tourist is willing to pay $13.295 for a beach improvement program, it is estimated that 3.2 million tourists visiting Hội An- as in 2017 - could have contributed $42.5 million. In 2019, The City of Hội An requested the Government fund $30 million for an urgent protection program for coastal erosion protection. However, the Government has decided to allocate $13 million for constructing about 1.030 km of revetments (Decree 797/NQ-UBTVQH14). Given the Hội An coastline is 7.6km long, it can be expected that the contribution from tourists could sufficiently fill the budget gap.

Chapter 3

The effect of knowledge and experience on choices among differing coastal erosion management programs in Hội An (a UNESCO World Heritage Site)[1]

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3.1 Introduction

Sandy beaches account for one-third of global coastlines and play a crucial role in the socioeconomic development of maritime nations. In particular, coastal beaches provide high values of recreation, tourism as well as ecosystem services. Coastal erosion therefore represents a significant threat to local residents in many forms including direct welfare loss due to damage to residential properties and households' livelihoods. This is particularly serious in areas heavily dependent on tourism activities. In the face of climate change, Vousdoukas et al. (2020) show that if no action is taken to stop the increasing trend of erosion, it is possible that half of the world's sandy beaches could be lost by the end of the century. The increasingly serious trend in this form of erosion poses a significant risk in highly populated regions of developing countries in South America, Africa and South East Asia. Hence, there is an urgent need for governments to effectively design and implement adaptive measures. This in turn requires a better evidence-based measure of the WTP for a variety of erosion protection programs draw from the insights and preferences of residents living in those areas. Literature on the preferences for coastal erosion prevention of local population has attracted increasing research interest (Huang et al., 2007; Castaño-Isaza et al., 2015; Halkos and Matsiori, 2018; Landry et al., 2020). Nevertheless, many past studies looking at residents' WTP for different erosion prevention measures have been conducted in developed countries or regions. While it is common for policy practitioners to transfer values estimated from research in developed countries and apply these values in the context of developing countries, this practice is exposed to high levels of error. For instance, the socioeconomic characteristics of populations in developed countries differ significantly from those in developing countries. Hence, estimated values for the willingness to pay for differing erosion protection programs of people living in developed countries are likely be different from those living in developing countries. To reduce the effect of such errors, studies on the WTP for coastal erosion protection measures should be conducted in similar contexts. Unfortunately, there lacks empirical research on WTP for prevention of coastal erosion in developing countries. This research aims to fill in this gap by providing an empirical study of attitudes of the local population in Hội An, a popular tourist destination in Vietnam which was recognized as a UNESCO World Heritage Site in 1999.

Hội An is a coastal tourism hot spot in Vietnam. Annually, about five million of tourists visit this town, contributing 60% of the local region's income. However, in recent years, Hội An's coastline has been severely eroded, leading to extensive damage to coastal businesses and local tourism activities. Viet et al. (2015) estimate that the coastline surrounding Cua Dai beach - one of the most attractive beaches in Hội An - has retreated by 200m, rendering the area unsuitable for tourism activities. The local authorities have implemented various measures including hard and soft structures to protect some parts of the coastlines. However, budget constraints arise and cost-effective mitigation strategies have become a crucial consideration (Thinh et al., 2019). Accordingly, more accurate knowledge on the preference of local residents for differing coastal erosion protection programs in Hội An is needed and fed into the process of policy design and implementation.

This study uses a DCE survey to investigate the values that the local population place on different coastal protection programs. This methodology is well known in the literature - see for example Louviere et al. (2000). The DCE survey allows for a detailed examination of marginal WTP for various attributes of a policy. Such data can therefore help local authorities select the policy setting that is most desirable by local residents. Furthermore, as the DCE survey belongs to the stated preference type of methodology it captures not only use values (e.g. beach recreational activities) but also non-use values associating with erosion protection services and aesthetic features. Our empirical strategy also allows us to account for respondents' taste heterogeneity caused by different experiences and knowledge of environmental goods. This is important as the literature notes that these variables can have a significant impact on respondents' valuation of the valued goods (Kularatne et al., 2021; Czajkowski et al., 2015, 2016). Moreover, our empirical study investigates the scale of heterogeneity which reflects residents' choice randomness and explores factors that drive the randomness in their choice decision.

The paper is organized as follows. Section 3.2 provides a brief literature review on economic valuation of coastal management. Section 3.3 introduces the case study of Hội An. The methodology is presented in Section 3.4, followed by survey design and implementation in Section 3.5. Section 3.6 and 3.7 present estimation results and our conclusions.

3.2 Literature review

The literature on economic valuation of beach protection including beach erosion control is extensive and reviews on relevant studies have been provided elsewhere (e.g. Gopalakrishnan et al., 2016; Dribek and Voltaire, 2017; Landry et al., 2020). Many studies have shown that there is significant and positive demand for erosion management program (Huang et al., 2007; Halkos and Matsiori, 2018). In this section, we provide a brief review of those studies that investigate differences in the preferences with respective to differing programs of beach erosion prevention.

There are several techniques available to protect against coastal erosion which raises the question: which preventive measure can maximize social welfare? The various techniques can be classified into hard (or active) measures and soft (or passive) measures (Landry et al., 2020). Hard or active measures refer to direct defensive structures against erosion, such as the establishment of shoreline armouring with groynes or revetments. Soft or passive measures refer to more a subtle defence or management approach, including sandbagging, beach nourishment and shoreline retreat. Hard and soft measures can be useful in preventing further coastal erosion but at the same time can exhibit negative impacts on the overall beach quality such as loss of direct access to the beach or reduction of beach width. In many cases, hard measures can temporarily or permanently transform the beach into a construction zone or an area with permanent structures. The soft measures such as beach replenishment can improve beach width and dune height but may have negative impacts on the texture and colour of the beach in addition to direct impacts from sand mining and other replacement sites. Thus, while coastal erosion can result in diminished beach and dune quality, erosion prevention measures can also affect beach quality negatively.

Each of the techniques or measures to prevent coastal erosion may garner different levels of support among the general public, especially those who reside in the area. The techniques will also affect choice, experience, and value of beach recreational users as well. A shortcoming of the literature on coastal residents' value of beach quality is that there are only few studies that compare general public support and economic values among differing erosion management policies (Landry et al., 2020).

Loss of recreational area and direct access to the beach affects beach users' utility which translates into direct loss of welfare. Several authors have estimated damage of beach width loss in monetary terms. Castaño-Isaza et al. (2015), for example, estimated an aggregate loss of $72 million to tourism revenues for San Andres beaches when their width was eroded by half. Whitehead et al. (2008) measure the value of a policy that improves beach access and beach width. They find that improved beach access accounts for roughly 41% of annual aggregated benefit of southern North Carolina beach trips while improved beach width accounts for 8%. Respectively, per-trip individual consumer surplus for improved beach access and beach width is $25 and $7. Loss in beach width and accessibility also reduce visitors' intention to return and thus has a negative impact on tourism in the longer term. Schuhmann et al. (2019) show evidence that return decisions are sensitive to changes in all aspects of coastal and marine quality. Furthermore, the study of Landry et al. (2003) using hedonic pricing method, show that beach width is an important attribute affecting residential house prices. Interestingly, the authors shows that beach width does not only affect recreational and amenity values but can also mitigate flood and erosion risk. This study finds that house prices increase by $233 per meter of beach width. Recently, Landry et al. (2020) published a unique piece of research which showed significant welfare gains stemming from shoreline retreat, modest support for beach nourishment, and null values associated with shoreline armouring. Differences in the estimates of welfare gains across three distinct measures of coastal erosion management are based on estimated WTP of 803 households living in North Carolina (USA). Specifically, the authors estimate that the median WTP for shoreline retreat, beach nourishment and shoreline armouring at $22.20, $7.449 and $0.0998 per household per year, respectively. The study shows a clear preference of residents for soft measures over hard structures. As illustrated in Landry et al. (2020), knowledge of the preference of local residents can give an insight into which erosion management measures or policy would yield the largest social net benefits and into which preferences are more socially desirable. Unfortunately, such research in the context of developing economies such as Vietnam is not available in the literature – a gap our paper aims to fill.

3.3 Hội An case study

Hội An is a coastal city located in the south central coastal region of Vietnam, in Quang Nam province and was recognized by UNESCO as a World Heritage Site in 1999. The city has a natural boundary and extends over an area of 6,171 ha, of which 4,622 ha form an inland territory. It has a population of around 120,000.[2] This ancient city is considered both a cultural centre and an economic center of Quang Nam province and has made significant contribution to Vietnam's tourism development and economic growth. There were over four million visits by foreign visitors to Hội An in 2019, accounting for over one-fifth of total foreign visits to Vietnam.[3]

However, Hội An is among Vietnam's most severely damaged regions by coastal erosion. Viet et al. (2015) report that, over the period from 2004 to 2014, of the 9-km long coastline some 1.7km are extremely severely eroded (500m), 2.5km severely eroded (200m) and 2km moderately eroded (30-120m). Coastal erosion hinders tourism activities through damage to beaches and recreational infrastructures. This poses significant threats to properties and touristic experience which in turn can have a severe impact on the livelihood of the local population whose main economic activities rely on

[2]Hội An City portal. http://hoian.gov.vn/pages/chuyenmuc_view.aspx?idchuyenmuc=552
[3]Vietnam National Administration of Tourism. https://vietnamtourism.gov.vn/index.php/statistic/international

tourism. Since 2013, roads, sea dykes and coastal resorts along the beach have been damaged from erosion, and in some extreme cases, has led to permanent abandonment of million-dollars recreational establishments such as the Fusion Alya resort. The World Bank reports that over 80% of hotels in Quang Nam province are exposed to erosion and 15-40% are under threat of a 1-in-20-year coastal or riverine flood risk (Rentschler et al., 2020). Tourism revenue loss resulting from beach erosion in Hội An using a hedonic pricing method is put at a substantial $29.6 million (Thinh et al., 2019). The situation has further worsened given the increased occurrence of extreme climatic events due to climate change (UN-Habitat, 2014).

These developments clearly indicate the urgency with which local authorities need to implement more effective mitigation and adaptation strategies. However, Hội An is faced with limited financial and technological capabilities (UN-Habitat, 2014). To facilitate effective coastal erosion management, information on WTP for differing erosion management measures by local residents of Hội An is necessary.

3.4 Methodology

3.4.1 Discrete choice modelling

We use DCE which is a technique initially developed by Louviere and Hensher (1983) and Louviere and Woodworth (1983). In a DCE survey, first, each respondent is presented with a sample of hypothetical scenarios of two or more alternatives. Each alternative describes a set of varying attributes of interest, and each respondent is asked to select one alternative. The cost attribute plays an important role in DCE. This attribute allows for an estimation of a monetary valuation for other attributes of interest through the concept of WTP. According to utility theory, a respondent's choice reflects the option that yields the highest utility for that individual. The total utility derived from an alternative choice set is assumed to be dependent on the composition of the levels of each attribute of interest (Lancaster, 1966). Hence, the cost attribute allows an indirect computation of a respondent's WTP for each attribute included in the choice set. In this study, the choice experiment method is used to account for residents' preference relating to coastal erosion protection programs. This method allows the estimation of the marginal WTP for changes in coastal and marine qualities (beach sizes, amenities); a comparison between different management options (hard and soft measures) and the choice of a payment instrument (tourist tax, beach fee).

Louviere et al. (2000) develop a method that allows the integration of DCE with econometric analysis by applying the random utility model (RUM) (McFadden, 1974). Logit is the most widely used discrete choice model (Train, 2000). The respondent, i, faces a choice among J alternatives. The respondent obtains a certain level of utility U_{ij} from alternative j, with $j = 1, ..., J$. The respondent chooses the alternative that provides the greatest utility, i.e. alternative k if and only if $U_{ik} \geq U_{ij}$, for all $j \neq k$. Utility is decomposed accordingly -$U_{ij} = V(x_{ij}|\beta_n) + \epsilon_{ij}$- where $V(x_{ij}$ is the observed part and ϵ_{ij} is an unobserved part. The observed part of utility is usually specified as a linear function in parameters $V_{ij} = \beta_i X_{ij}$ where X_{ij} denotes a K-vector of observed attributes of alternative j. According to McFadden (1974), the ϵ_{ij} is assumed to be an independently, identically distributed extreme value and the parameter β_i is homogeneous across respondents. -i.e $\beta_i = \beta$ - which forms the classic multinomial logit (MNL) model:

$$U_{ij} = \beta X_{ij} + \epsilon_{ij} \tag{3.1}$$

A flexible model that is developed from the MNL model and is able to account for heterogeneity of preferences is MIXL model. The most popularly used form is based on random coefficients (Train, 2009). The utility of respondent i from choosing alternative j has been rewritten as:

$$U_{ij} = \beta_i X_{ij} + \epsilon_{ij} \tag{3.2}$$

where β_i is a vector of parameters for respondent i and is assumed to follow a continuous density.

3.4.2 Generalized multinomial logit (G-MNL) model

While the MIXL model has shown its ability to capture heterogeneity in preferences over observed attributes, it does not take into account the potential scale heterogeneity, i.e., differences in the scale of the idiosyncratic error term. Scale heterogeneity represents an important issue in the DCE, as it captures the variation of randomness in respondents' decision-making process and hence different degrees of certainty across respondents when they are facing different choice tasks.

The G-MNL model has recently been proposed to deal simultaneously with the issues of taste and scale heterogeneities (Fiebig et al., 2010). In this model, utility weights are defined as

$$\beta_i = \sigma_i \beta + (\gamma + (1-\gamma)\sigma_i)\, \Gamma \eta_i \tag{3.3}$$

where σ_i is the scale of the idiosyncratic error term for respondent i, β is the vector of the mean attribute utility weights, and η_i is the vector of respondent i's specific deviations from the mean. These deviations can be correlated, with Γ denoting their covariance matrix. The parameter γ, with $\gamma \in [0,1]$, governs how the variance of the residual varies with scale in a model. To better understand this, we must consider the two polar cases at the boundaries of the interval for γ. Thus,

$$\beta_i = \sigma_i \beta + \Gamma \eta_i \quad \text{if} \quad \gamma = 1 \;\; \text{(GMNL-I model) and} \tag{3.4}$$

$$\beta_i = \sigma_i (\beta + \Gamma \eta_i) \quad \text{if} \quad \gamma = 0 \;\; \text{(GMNL-II model)} \tag{3.5}$$

Note that, in either the GMNL-I or GMNL-II models, the vector of utility weights can be written as $\beta_i = \sigma_i \beta + \eta_i^*$ where the random variable σ_i captures scale heterogeneity and η_i^* captures residual taste heterogeneity. The main difference between the two models is that in model (3.4), the standard deviation of η_i^* is independent of the scaling of β, whereas in model (3.5), it is proportional to σ_i.

The description of the G-MNL model is complete once the distribution of σ_i is specified. As it is a scale parameter, it should have positive support. It is then customary to assume that σ_i is distributed as log-normal, i.e., $\log \sigma_i \sim \mathcal{N}(\overline{\sigma}, \tau^2)$. Note that $\overline{\sigma}$, τ and β are not separately identified. Identification is achieved by calibrating $\overline{\sigma}$ so as to normalize $\mathbb{E}(\sigma_i) = 1$, allowing τ and β to be free.[4] Thus, the estimated β are interpretable as mean utility weights.

Note that the MNL and the MIXL models can be viewed as special cases of the G-MNL model by setting $\sigma_i = 1$ and $\eta_i = 0$, or $\sigma_i = \sigma = 1$, respectively. The scale heterogeneity (S-MNL) model proposed by Swait and Adamowicz (2001), which assumes that $\beta_i = \sigma_i \beta$, is also nested in the G-MNL model.

Moreover, the scale mean can vary across respondents with the addition of individual-specific characteristics. A random scale parameter can thus be written as:

$$\sigma_i = exp(\overline{\sigma} + \theta s_i + \tau) \tag{3.6}$$

where s_i is the vector of individual-specific variables.

Parameters in the MIXL and G-MNL models are estimated using maximum simulated likelihood, while those in MNL model can be estimated using classical maximum likelihood techniques (for the derivation of choice probabilities, see Keane and Wasi, 2013).

3.4.3 WTP-space

The WTP for a given attribute is defined as the marginal rate of substitution between this attribute and a monetary attribute (Train, 2009). In random utility models with linear utility specification and without any taste heterogeneity, WTP can be obtained by the ratio of the non-monetary attribute utility weights and the monetary attribute utility weight multiplied by minus one. Estimates of WTP can be easily recovered

[4] As $\mathbb{E}(\sigma_i) = \exp(\overline{\sigma} + \tau^2/2)$, normalization is achieved by setting $\overline{\sigma} = -\tau^2/2$.

by taking the ratio of estimated values of the aforementioned utility weights. Train and Weeks (2005) proposed a direct way to estimate WTP, using the so-called the WTP-space. They point out that the estimation of models in WTP-space have greater behavioral implications. This has been confirmed by further studies such as that of Hensher and Greene (2011) and Rose and Masiero (2010). Moreover, Scarpa et al. (2008) reported that the fit of a model in WTP-space model is better than the fit in a preference-space model.

The WTP-space approach can be motivated as follows. Consider the simple case of the conditional logit model, where the vector of attributes is divided into to the monetary attribute, p_{ij}, and non-monetary attributes, x_{ij}. In preference-space, the utility of alternative j for individual i then becomes:

$$U_{ij} = \beta^c p_{ij} + \beta^{nm} x_{ij} + \varepsilon_{ijt} \tag{3.7}$$

where β^c and β^{nm} are now utility weights for monetary and other non-monetary attributes. The WTP for non-monetary attributes is simply the ratio $-\beta^{nm}/\beta^c$.

The utility in WTP-space is obtained by dividing the attribute utility weights by the price coefficient as follows:

$$\begin{aligned} U_{ij} &= \beta^c \left[p_{ij} - \left(-\tfrac{\beta^{nm}}{\beta^c} \right) x_{ij} \right] + \varepsilon_{ijt} \\ &= \beta^c \left[p_{ij} - \phi x_{ij} \right] + \varepsilon_{ijt} \end{aligned} \tag{3.8}$$

The vector of WTP, or ϕ, can then be estimated directly using Equation (3.8), where monetary utility weight is normalized to minus one.

In the simple conditional logit (CL) model, writing utility in WTP-space corresponds to a one-to-one transformation of the parameters of original utility in preference-space. However, the transformation is more complicated when parameters are random and scale heterogeneity is considered. Nevertheless, Greene and Hensher (2010) and Hensher and Greene (2011) point to a special case of the G-MNL model that can be reparameterized in WTP-space in the presence of both taste and scale heterogeneity, namely the GMNL-II model where $\gamma = 0$. Indeed, Equation (3.5) can be parametrized to become the G-MNL model in WTP space by normalizing the utility weight for the monetary attribute to one inside the bracket, which results in:

$$\beta_i = \begin{pmatrix} -\beta_i^c \\ \beta_i^{nm} \end{pmatrix} = -\sigma_i \beta_i^c \begin{pmatrix} 1 \\ \frac{1}{-\beta_i^c}(\beta^{nm} + \Gamma^{nm}\eta_i^{nm}) \end{pmatrix} = -\sigma_i \beta_i^c \begin{pmatrix} 1 \\ \phi + \Pi^{nm}\eta_i^{nm} \end{pmatrix} \quad (3.9)$$

where Γ^{nm} and η_i^{nm} are Γ and η_i, excluding the monetary attribute weight. As pointed out by Train and Weeks (2005), the common denominator in ϕ and Π^{nm} induces correlation among all non-monetary attributes, even if they are not correlated in the G-MNL model expressed in preference-space.

3.5 Survey design and implementation

3.5.1 Survey design

A seminar was organized in 2017 in Hội An where local experts on climatology, hydrology and sociology who had worked on the morphological changes and consequences of Hội An beaches discussed their findings. Additionally, local authority officers, non-governmental organizations (NGOs), environmental activists, and representatives from Hội An residents were consulted regarding the preliminary design of the survey questionnaire. This process aimed to ensure that the design of the survey was in line with existing management strategy of the local authority and reflected major components of the subjective valuation for coastal and protection attributes of local residents. For instance, the types of beach facilities, protective structures and their combination with beach nourishment efforts were selected to form alternative measures of coastal erosion prevention. These were adapted from existing or planned protection measure developed by local authorities. A subsequent focus group discussion and a literature review were conducted after the seminar to further refine the preliminary version of the questionnaire. A pilot survey with a sample of 120 households was implemented followed by the final survey. The framework is illustrated in Figure 3.1.

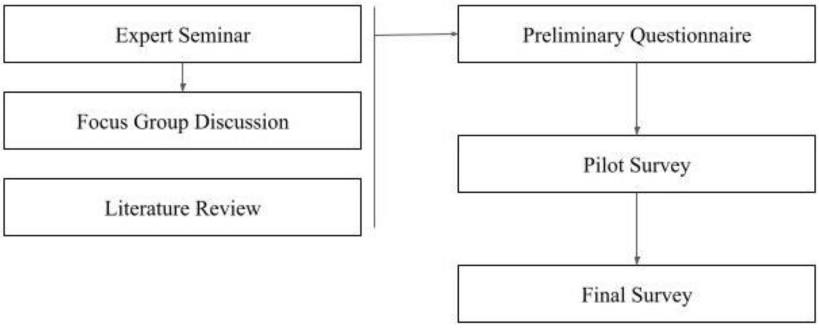


Figure 3.1: Questionnaire development framework

The final set of attributes detailed in Table 5.1 includes type of protection structure, beach width, public access portion, beach facility and local tax. Given the large population and property density in the survey region some soft protection measures such as shoreline retreat were not feasible. All protection policies considered were combinations between the implementation of a protection structure and beach nourishment efforts - indicated in an increased beach width.[5] It is accepted that payment vehicles must be binding, mandatory and popularly accepted within a given population (Mariel et al., 2020). In valuation of coastal management, examples of payment vehicles are parking fees (Oh et al., 2010; Dixon et al., 2012; Logar and den Bergh, 2014), contribution fee (Beharry-Borg and Scarpa, 2010), and household tax (Matthews et al., 2017b; Christie et al., 2015; Ardeshiri et al., 2019; Spencer-Cotton et al., 2018). In a meta-analysis of wetland valuation, Brouwer et al. (1999) point out that tax generally results in the highest WTP and is better suited compared to other payment vehicles. In the case of Hội An, we chose a local tax since it was expected to apply to the whole city population and not limited to only beach users.

[5]The current beach width is about 0 to 50 meters depending on beach segments. The beach width was up to 180 meters 15 years ago (Fila et al., 2016). We selected the maximum of beach width level as 150 meters for its relevance

Table 3.1: Attributes in a coastal erosion protection policy alternative

Attribute	Definition	Level
Protection structure	Type of structure to be built along the coastline for erosion protection	No structure Sandbag Stair revetment Concrete revetment Groynes
Beach width (meter)	Average beach width measured at high tide. Beach width increase using beach nourishment technique.	0, 25, 50, 75, 100, 150
Public beach (%)	Percentage of beach freely accessible for all	0, 25, 50, 75, 100
Beach facility	Type of beach facility available	Nothing Tree Restaurant Tree and restaurant
Local tax	An annual local tax levied on Hội An residents aged 18-60 and used to fund the erosion protection program	0, 50, 100, 150, 200 thousand VND

Each respondent is asked to choose from three alternatives including two alternative policies and a status quo option. Figure 3.2 is an example of a choice set.

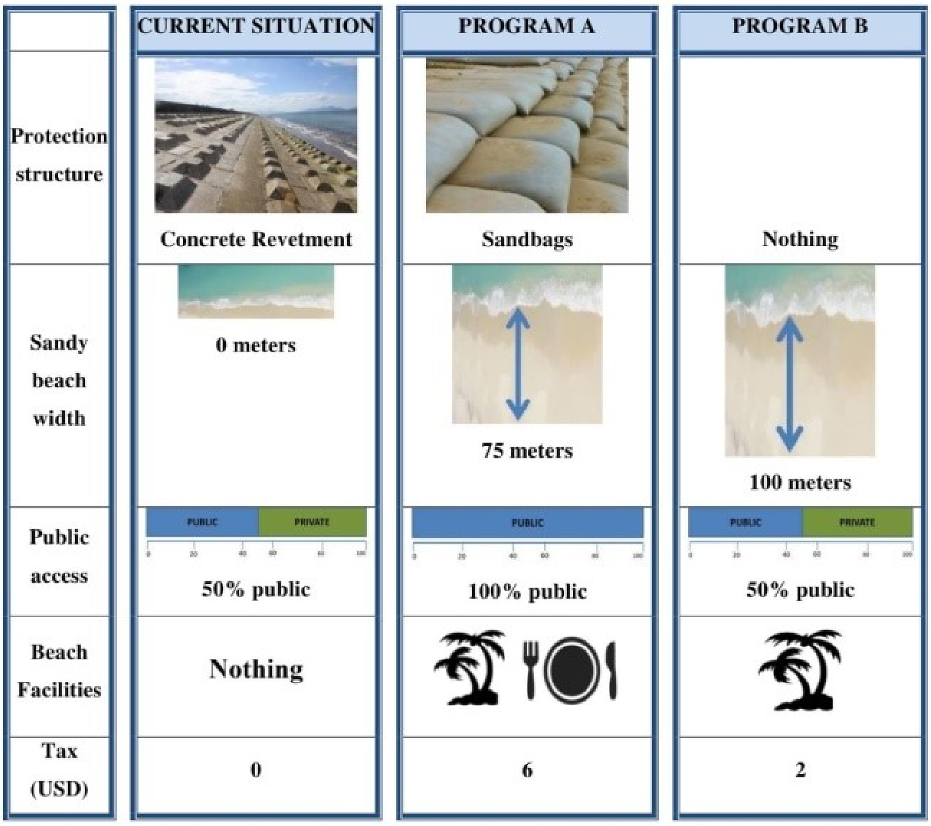


Figure 3.2: Example of a choice set

The coastline in Hội An is characterized by segments which display different erosion rates and a variety of existing protective structure (Viet et al., 2015). Therefore, the coastline was divided into four separated segments.

Beach A This beach is most affected by erosion. Hence, a concrete revetment has already been constructed. It used to be a touristic destination with several hotels and resorts in the past but has been severely damaged by erosion to the extent that coastal tourism in this beach is restricted.

Beach B Beach B has lost 60 - 120 meters of beach width but currently no protective measure are implemented.

Beach C Beach C is a popular beach and attracts many tourists but is subject to an alarming level of coastal erosion. Sandbag protection is implemented on this beach.

Beach D Beach D is the least eroded and no current protective measure are in place. It is also the only beach with full public access.

The discrete choice survey was designed for these four beach segments. Each respondent was randomly assigned to a questionnaire of one beach segment. The respondent was asked to select one alternative among three, each with varying levels of the five attributes as described above. The design for the choice set was produced from the D-efficient design using *Stata* software and a prior from pilot data. 18 choice sets were produced for each beach segment, which are grouped into three blocks so that each respondent was presented with six choice sets.

The survey questionnaire consisted of four parts. Part 1 asked questions on the attitude and awareness of local residents toward coastal erosion. Boyer-Villemaire et al. (2014) remark that direct experience of coastal erosion can raises awareness and this in turn can have an effect on an individual's perceptions about the effectiveness of coastal management program. Part 2 consisted of the discrete choice survey. We employed a video survey which is suggested by several authors to help raise the engagement of survey participants and reduce choice error (Balcombe et al., 2015; Bateman et al., 2009; Matthews et al., 2017b). Specifically, the video survey provided participants prior information about the current state of the beaches. This informed the assessment of the consequences of the erosion and a 10-year projection of the level of impact. Thus, providing this information helped respondents understand the current context of Hội An beaches and reduced uncertainty associated with a lack information. Part 3 collected demographic characteristics and Part 4 presented questions on risk preference.

3.5.2 Survey implementation

The survey was presented in electronic form and data automatically collected through the application SurveyCTO. Each respondent was guided to give answers using a provided tablet. An incentive of VND 40,000 was given to each respondent upon completing the survey. Six local college students studying economics and environment were employed and instructed by two university lecturers. This provided a total of eight interviewers. The official survey was held in July 2018 with a sample of 399 households. Samples were selected using the stratified and random sampling method, thereby stratifying by administrative level and providing an arbitrary selection based on population proportion of the administrative level. A total of 73 villages within the boundary of 12 inland communes were included in this way. The number of respondents per village was selected based on the proportion of the village population to the city population. This method ensured the representativeness of the sample.

3.6 Result

3.6.1 Sample description

Table 3.2: Survey sample summary statistics

	Description	Our sample	VHLSS Sample*
Gender (% sample)	Female	31.3	34.5
	Male	68.7	65.5
Age	Mean	52	58.3
	Min	18	27
	Max	86	90
Education level (% sample)	High school diploma and lower	70.6	77.1
	University and higher	29.4	22.9
Household monthly income (% sample)	Below 10 million (VND)	62	80.3
	10 - 20 million (VND)	28	12.8
	Above 20 million (VND)	10	6.9
Beach visit (% sample)		90.6	
Reason to visit beach (% sample)	Swimming	61.7	
	Relaxing and Landscape	70	
	Seafood Restaurant	18	
	Working	7.8	
Acknowledge erosion in Hội An (% sample)		94	
Severity of environmental issues (Mean) *Likert scale, 1-Not serious, 5-Very serious*	Air pollution	2.7	
	Water pollution	2.9	
	Loss of biodiversity	2.5	
	Temperature warming	3.4	
	Flood	3.3	
	Coastal erosion	4.3	
Impact of coastal erosion (Mean) *Likert scale, 1-No impact, 5-Very high impact*	Property loss (houses, lands, etc.)	1.9	
	Loss of economic activities	2.3	
	Loss of recreational activities	2.5	

*Source: Vietnam Household Living Standard Survey 2018, data description for the household leader.

Summary statistics for demographic characteristics of respondents, reason to visit, environmental attitudes and erosion experience are reported in Table 3.2.

There was an inequality in gender proportion in the survey sample - more than two-thirds of the respondents being male. The range of respondent age fell between 18 and 86 with an average of 52 years. The portion of residents with university degree or higher was less than 30%, although this did not seem to strongly affect the respondent's acknowledgement of erosion in Hội An. Only 6% of the sample were unaware of the situation. A major portion of residents visited the beach for a number of reasons including swimming (61.7%) relaxation and enjoyment of the scenery (70%). About one-fifth of the sample also visited the beach restaurant and 7.8% of the respondents work at these facilities.

In comparison with the Hội An sample in Vietnam Household Living Standard Survey (VHLSS) in 2018, our sample exhibited a similar share of gender and education level, but was slightly older and had a higher average level of income.

On average, respondents seemed to be aware of the presence of environmental issues, and in particular the more serious issues of pollution, climate change and natural disasters. Interestingly, coastal erosion was regarded to have the highest level of severity (4.3) among all environmental issues. This reflected the general acknowledgement of erosion as a serious issue among Hội An residents. Regarding damage from coastal erosion, most respondents believed that the loss of economic activities and recreational activities were more problematic than the damage to local properties and infrastructure.

3.6.2 Estimation result

The models were estimated by *gmnl* package in R (Sarrias and Daziano, 2017). Choice probabilities were simulated using Halton draws (Train, 2009), taking into account the panel structure of the data. We used effect coding for categorical attributes, including structures and facilities. This required that the reference level was coded -1, the presented attribute level coded 1 and the other levels 0. All parameters were assumed to be normal distributed. We added an alternative-specific constant (ASC) to account for the status quo effect (Scarpa et al., 2005). Parameters were scaled according to Equation (3.5), except ASC parameter. Fiebig et al. (2010) show that scaling the ASC can result in the estimates becoming exceptionally large as τ and the standard errors of estimated utility weights can take on very large values. We chose to estimate the GMNL-II specification with correlated attributes because this specification can be reparameterized in WTP-space, avoiding computational issues encountered when computing WTP using estimation results in preference-space. Table 3.3 presents a description of variables.

Table 3.3: Description of variables

Variables	Value	Description
Width	Continuous variables in kilometers	Width attribute
Access	Continuous variables in percentage	Access attribute
ASC	1 if respondent choose status quo option 0 if respondent doesn't choose status quo option	Status quo option
Tax	Continuous variables in USD	Tax attribute
Restaurant Restaurant-tree Tree	Dummy variable 1 if the facility is chosen 0 if the facility is not chosen	Facility attribute
Groynes Sandbag Concrete revetment Stair revetment	Dummy variable 1 if the structure is chosen 0 if the structure is not chosen	Protection structure attribute
Being impacted	1 if respondent is highly impacted by erosion 0 if respondent is less impacted by erosion	Ranking of impact of coastal erosion on respondent's own life
High rate of severity	1 if ranking by respondent is above 3 0 if ranking by respondent is equal or below 3	Respondent's ranking of severity level of coastal erosion in Hội An by Likert scale
Acknowledgement	1 if YES 0 if NO	Respondent thinks that Hội An is facing problems due to coastal erosion
Tourism related	1 if YES 0 if NO	Respondent works in economic activity that is related to tourism
Education	1if YES 0 if NO	Respondent has a college degree or above
Certainty	1 if ranking by respondents is above 3 0 if ranking is equal or below 3	Respondents' ranking of their certainty about their choice by Likert scale

Results in preference-space

Valuation of residents

The views of residents on coastal erosion management programs are presented in Table 3.4. Generally, residents favour a wider and highly accessible public beach, as the parameters for Width and Access are significantly positive in estimations of the MNL, the MIXL and the G-MNL models. These findings align with previous studies (Dixon et al., 2012; Rolfe and Flint, 2018).

With respect to beach facilities, estimations indicate an inclination of residents to have more diverse facilities on the beach, preferentially having both restaurant and trees. Concerning protection structures, parameters for groynes, concrete revetments and sandbags are significant and positive, indicating that residents place a greater value on the presence of protective structures along the coastline than having nothing. Groynes are the most preferred structure. As explained by Boyer-Villemaire et al. (2014), the preference for an erosion management option could be attributed to the awareness of the local population arising from their direct experience with erosion. However, we note that while there is a consensus in their preferences for a protection policy, the literature often indicates respondents view visible protective structures as a disutility (Matthews et al., 2017b). Moreover, the significance of the standard deviation in the MIXL and G-MNL estimations indicates a preference heterogeneity across respondents on most of the attributes including beach access, width, all protection structures and facilities.

Table 3.4: Preference of residents towards coastal erosion management program

Attributes	MNL	MIXL	G-MNL	G-MNL with scale drivers
Tax	-0.122(0.011)***	-0.285(0.027)***	-3.712(0.367)***	-25.854(9.497)***
ASC	0.098(0.079)	-0.073(0.195)	-0.514(0.19)***	-0.514(0.223)**
Width	4.014(0.638)***	6.805(1.368)***	10.035(1.618)***	32.383(14.311)**
Access	0.431(0.079)***	0.908(0.18)***	1.076(0.21)***	8.671(3.303)***
Restaurant	-0.01(0.055)	0.059(0.101)	0.019(0.112)	-1.159(0.847)
Restaurant-tree	0.271(0.041)***	0.371(0.099)***	0.334(0.114)***	3.168(1.34)**
Tree	-0.098(0.045)**	-0.145(0.088)*	-0.063(0.098)	-1.721(0.828)**
Groynes	0.187(0.065)***	0.497(0.132)***	0.456(0.146)***	2.726(1.546)*
Concrete revetments	0.091(0.051)*	-0.173(0.134)	0.185(0.138)	3.689(1.523)**
Stair revetments	0.049(0.064)	0.162(0.124)	0(0.152)	0.997(0.876)
Sandbags	0.044(0.051)	0.348(0.109)***	0.142(0.116)	1.869(1.21)
Standard deviation				
Tax		9.83(1.954)***	14.133(2.134)***	90.252(34.358)***
ASC		2.268(0.224)***	2.792(0.326)***	2.984(0.281)***
Width		2.141(0.265)***	2.466(0.333)***	19.917(7.455)***
Access		0.342(0.032)***	3.88(0.37)***	25.116(9.266)***
Restaurant		0.173(0.156)	0.148(0.153)	1.955(1.066)*
Restaurant-tree		1.03(0.138)***	0.972(0.14)***	6.623(2.441)***
Tree		0.474(0.128)***	0.439(0.121)***	2.486(1.03)**
Groynes		1.354(0.145)***	1.837(0.182)***	11.181(4.223)***
Concrete revetments		1.117(0.179)***	1.62(0.237)***	9.61(3.675)***
Stair revetments		1.285(0.219)***	1.666(0.221)***	9.604(3.623)***
Sandbags		1.9(0.194)***	2.112(0.236)***	12.022(4.507)***
Scale parameter drivers				
τ			0.538(0.083)***	0.849(0.078)***
Acknowledgement				-2.186(0.386)***
Certainty				0.677(0.163)***
Education				0.925(0.17)***
Loglikelihood	-2415.98	-1951.04	-1933.38	-1427.04
AIC	4853.96	4056.09	4022.77	3016.07
BIC	4917.55	4501.20	4473.66	3463.60

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Scale heterogeneity

The estimation of G-MNL model in the fourth column in Table 3.4 reveals a significant scale heterogeneity (τ), reflecting choice randomness among respondents. It can be seen that distribution of the scale heterogeneity for residents has a wide spread. The main part of the estimated scale parameter is below one, and thus the weight that respondents put on the deterministic part of utility is lower than one. This reflects that residents have a relatively high degree of choice randomness.

A possible explanation for the observed choice randomness is the existing relationship between scale heterogeneity and prior experience of the good being valued (Czajkowski et al., 2015), the level of education (Czajkowski et al., 2014), the availability of information preceding the survey (Czajkowski et al., 2016), task complexity, and the cognitive ability of respondents (Christie and Gibbons, 2011). In order to explore which factors drive the scale heterogeneity in our study, three variables representing education level, acknowledgment of the problems caused by coastal erosion, and stated level of choice certainty were incorporated in the mean of the scale. The final column in Table 3.4 presents the estimation results of the G-MNL model with these factors.

Estimation results show that "Education" and "Certainty" significantly increase the scale mean, whereas "Acknowledge" shows that respondents who have a higher level of education and who display greater certainty in their choice question tend to make less random choice decisions. On the other hand, those who think that coastal erosion causes issues in Hội An exhibit a higher level of randomness in their choice decision. That is, their choice is driven more by the error term than by interpreting the attributes in the choice tasks.

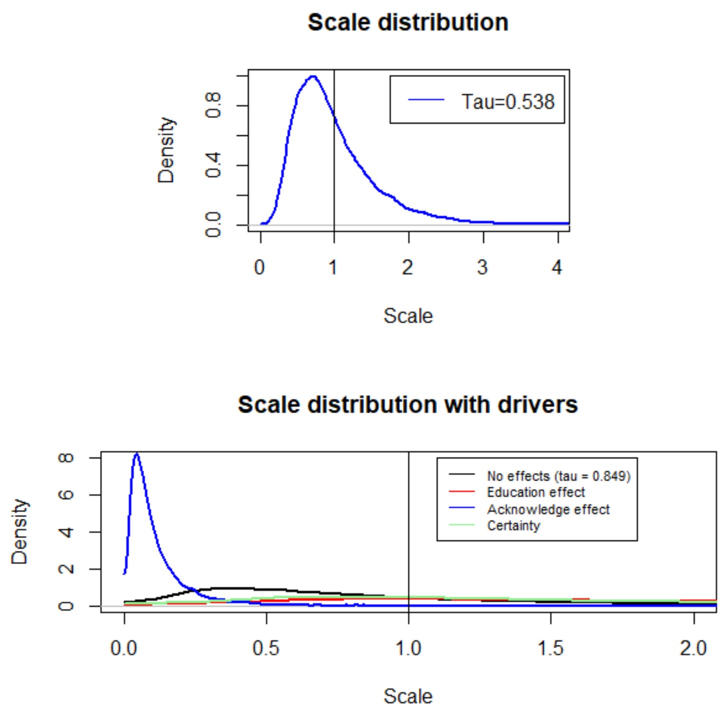


Figure 3.3: Scale distributions with scale parameter drivers

Figure 3.3 shows how the density of the scale parameter evolves with significant drivers. Due to the effect of the acknowledgement of the issues caused by erosion, the distribution of the scale parameter moves to the left side of one with a high probability for values close to zero. This implies that in accepting coastal erosion as a problem in Hội An, this leads respondents to put a very small weight on the deterministic part of utility. This in turn suggests that, for respondents who think that coastal erosion causes problems in Hội An, the choice decision about the coastal erosion protection program is less driven by interpreting the choice experiment. It is also noteworthy that most residents (94%) are known to be aware of the issue of erosion in Hội An. The high level of education and certainty causes the density of the scale parameter to be concentrated above one, which decreases the weight that respondents put on the error term for utility. Thus, the respondents who have college degrees or higher (18.8% of residents) seem to pay more attention to evaluating attributes than others do when they make their choice in the DCE.

In summary, it may be more challenging for most residents in Hội An to analyze the choice task with different scenarios and attributes due to the level of task complexity. However, where there is an acknowledgment that Hội An is facing a problem due to coastal erosion, this makes their choice less driven by their interpretation of the DCE.

Interaction effects

To account for the observed preference heterogeneity of Hội An residents, we tested the interaction effect of attributes with three variables introducing experience and acknowledgement of residents towards coastal erosion issues and one variable representing the economic activity of respondents using the MNL model. The significant interactions are presented in Table 3.5.

Negative interactions relating to the high rate of severity with tree and beach width indicate that residents who think that there is severe coastal erosion are less inclined to want a wider beach or a beach having only trees than other respondents. Likewise, respondents who are aware of the high impact level erosion has on beaches have a disinclination to accept the current situation of either only trees or restaurants on the coastline. Moreover, residents who think that coastal erosion is causing a problem in Hội An place a higher value on all type of protective structures than other respondents. Similarly, residents who are highly impacted by coastal erosion are shown to have a greater preference for concrete revetments than those who are less impacted. In addition, the significant and positive interaction of the variable "Tourism related" suggests that people who work in tourism related activities tend to prefer beaches with both restaurants and trees. With regards to protection structures, this group of respondents inclines to groynes, stair revetments and sandbags. These structures not only protect the coastline from erosion but also provide visitors with better access to the sea.

Table 3.5: Interaction effects

Interaction effect	Coeff
Tree x high rate of severity	-0.352(0.196)*
Width x high rate of severity	-0.003(0.002)*
Tax x being impacted	0.003(0.001)**
Restaurant x being impacted	-0.449(0.259)*
Tree x being impacted	-0.681(0.231)***
Concrete revetment x being impacted	0.569(0.221)**
Tax x acknowledgement	-0.004(0.002)*
Groynes x acknowledgement	0.751(0.439)*
Stair revetment x acknowledgement	1.143(0.411)***
Concrete revetment x acknowledgement	1.411(0.342)***
Sandbags x acknowledgement	0.636(0.301)**
Restaurant-tree x tourism related	0.309(0.17)*
Groynes x tourism related	0.469(0.223)**
Stair revetment x tourism related	0.42(0.224)*
Sandbags x tourism related	0.35(0.175)**

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Estimation in WTP-space

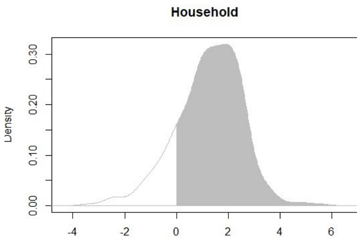
Estimations in WTP-space are presented in Table 3.6 with starting values taken from the correlated MIXL model. Generally, residents are willing to pay more for a beach having both trees and restaurants - \$0.39. Residents are willing to pay \$0.464 to \$0.676, respectively for a beach that is protected by groynes and stair revetment. WTP for access and width are approximately \$0.0127 and \$0.0107 for additional public access and one additional meter of beach width, respectively.

Table 3.6: WTP-space estimation

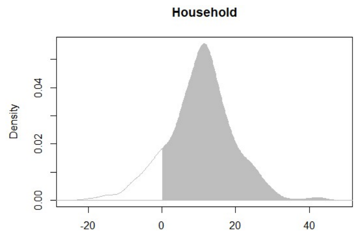
Attribute	WTP-space	Standard deviation
ASC	2.045(0.181)***	2.408(0.212)***
Width	10.724(1.363)***	12.244(1.533)***
Access	1.266(0.183)***	0.456(0.124)***
Restaurant	0.082(0.097)	1.309(0.123)***
Restaurant-tree	0.39(0.099)***	0.547(0.127)***
Tree	0.03(0.085)	1.321(0.175)***
Groynes	0.464(0.123)***	1.758(0.228)***
Concrete Revetment	-0.314(0.126)**	0.915(0.199)***
Stair Revetment	0.676(0.111)***	2.44(0.214)***
Sandbags	0.193(0.124)	1.705(0.159)***
Scale parameter		
τ		0.071(0.089)

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

The distributions of conditional estimates of individual WTP (Greene, 2018) are displayed in Figure 3.4-3.6 using a kernel density estimator (Silverman, 1986). Most residents are willing to pay for a wider public beach. In relation to facilities, most residents are willing to pay more for a beach with more facilities. Figures 3.6 shows that more than half of residents are ready to pay for sandbags, groynes and stair revetments, but only 43% of resident show a WTP for concrete revetments.

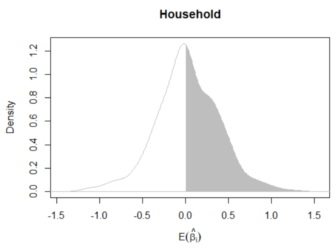


(a) Access

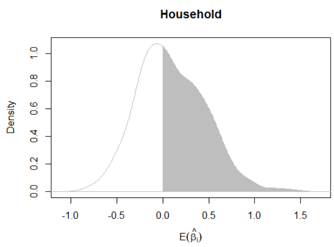


(b) Width

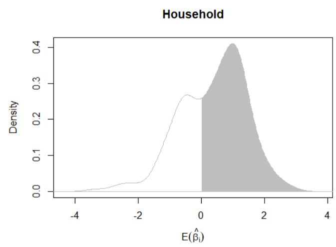
Figure 3.4: Individual-specific WTP-space distribution for Access and Width



(a) Trees

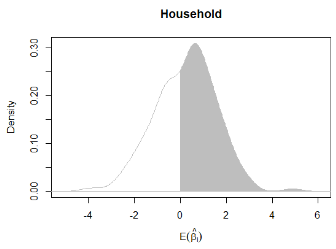


(b) Restaurants

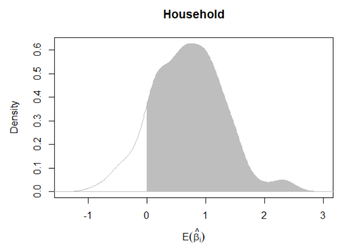


(c) Restaurant-tree

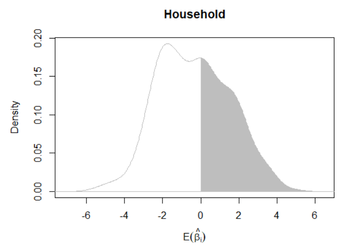
Figure 3.5: Individual-specific WTP-space distribution for facilities



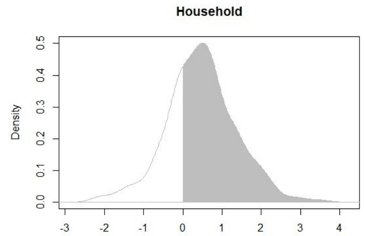
(a) Sandbags



(b) Revetment stairs



(c) Concrete revetment



(d) Groynes

Figure 3.6: Individual-specific WTP-space distribution for protection structures

3.7 Conclusion

This paper presents residents' valuation of different measures proposed for coastal erosion protection management in Hội An, a city which has been seriously affected by coastal erosion. Empirical results show that residents value a wider and more public beach but interestingly are inclined to favour a beach that is protected by visible structures such as groynes and stair revetments. This suggests that a combination of coastal defence structures and beach nourishment is a preferred management program by the local population. With regards to beach facilities, residents prefer to have both restaurants and trees.

Our results indicate a preference heterogeneity across respondents. Knowledge and experience about coastal erosion can influence their valuation for a protection program. Residents who are highly impacted by coastal erosion or have knowledge of the coastal erosion problem in Hội An tend to place higher values on the construction of protection structures. Being highly impacted by erosion leads residents to be willing to pay a tax to be used for erosion management. At the same time, residents who work in the tourism sector prefer protection structures that are not only capable of mitigating erosion but also allow visitors easy accessible to the sea. Using the G-MNL model, we find a strong scale heterogeneity (high level of randomness) across respondents. This may reflect the presence of respondents with set/lexicographic approaches to choice and who therefore express strong preferences for some specific attributes, regardless of other attributes. Respondent randomness is mainly driven by prior knowledge of coastal erosion, and by difficulties in interpreting the choice tasks of the DCE. This result confirms that scale heterogeneity is affected by the complexity of the choice set and by the cognitive ability of respondents. Contrary to the finding of Czajkowski et al. (2014), we report that respondents with higher education levels are more deterministic in their choices.

Our empirical results provide several important policy implications. First, local residents are willing to contribute to funding which is used for coastal erosion management in Hội An. For example, a program that increases beach width by additional 50 meters, beach access by an additional 25%, has restaurants and trees on the beach and groynes as the erosion protection structure, can generate an average WTP of $1.7 per year per resident. Second, a combination of beach nourishment and construction of protection structures rather than only beach nourishment is preferred by residents.

Through this research we have demonstrated that the potential financial contribution of Hội An's population to coastal management programs are significant, as there has been for other environmental programs in Vietnam such as flood risks reduction in Nghe An (Reynaud and Nguyen, 2016), insurance for natural disasters (Reynaud et al., 2018), mangrove forest restoration of the Cat Ba Biosphere Reserve in Hai Phong (Pham et al., 2018b), coral conservation and control of marine plastic pollution in Nha Trang (Börger et al., 2021).

Future studies can examine the uncertainty associated with multiple attributes among residents so as to understand and categorize major groups of behaviours and preferences. Moreover, due to the different location of respondents, WTP estimates and values may vary across space (Glenk et al., 2020). A further exploration on spatial preference heterogeneity could therefore be examined. In addition, using a split-sample, differences of preferences for different coastal erosion management program on different beach segments could be explored. Lastly, this study could be expanded to investigate compatible payment vehicles for funding in a developing country context.

Chapter 4

How tourists and residents value coastal erosion management programs? New evidence from Hội An (Vietnam), a UNESCO World Heritage Site[1]

[1] This chapter has been recently submitted.

4.1 Introduction

The tourism sector contributes to several high-priority objectives in developing countries, including generation of income, creation of employment opportunities, foreign-exchange earnings, and social development.[2] The growth of touristic activities may also generate some environmental concerns, both at regional and local levels.[3] In particular, major tourist destinations are facing challenges related to water supply, waste generation and management, and air and noise pollution. Increasingly threatened by their own popularity, tourist destinations must move toward more sustainable tourism, making efficient use of environmental resources, respecting local populations, and ensuring long-term benefits for all stakeholders. Reconciling these objectives remains a challenge in many locations.

The Vietnamese city of Hội An is a good example of a location facing such challenges. Its ancient town has been listed as a UNESCO World Heritage site since 1999, and its main beach (Cua Dai beach) is regularly referred to as one of the most beautiful in Vietnam. Tourism is a strategic economic sector since it accounts for nearly 64% of the city's revenue. In 2019, the City of Hội An received 5.35 million visitors for a resident population of approximately 98,600. However, in the last ten years, Hội An has faced coastal erosion that is so severe that sandy beach is no longer present in some areas, threatening shore-adjacent buildings. The economic cost of coastal erosion in Hội An is high: the annual loss of tourism revenue due to coastal erosion represents $29.6 million in 2020 (Thinh et al., 2019). As a result, coastal preservation and mitigation have been major priorities for the City of Hội An.

A wide range of measures can be taken to limit coastal erosion, including soft measures (restoring the beach by using sand from elsewhere or by steering the natural process of sediment supply) and hard measures (man-made structures that protect the

[2]Tourism plays a significant role in the global economy, accounting for 10.4% of world GDP and 10% of total employment in 2018 (WTTC, 2019).

[3]Travel and tourism is one of the world's fastest-growing sectors (+3.9% in 2018, outpacing global economic growth for the eighth consecutive year). This role is likely to be reinforced in the future, in particular due to the continued rise in the number of middle-class households.

shore from further erosion such as concrete seawalls, revetments, groynes). Proposing an efficient mix of measures implies a deep understanding of policy preferences, both for the local population and for tourists. The design of an efficient coastal management policy can thus be complicated if preferences of tourists and residents differ for a specific coastal erosion management program. This is the central issue that we will investigate here.

The purpose of our study is to provide an in-depth comparison of tourists' and residents' preferences for alternative coastal erosion management programs in Hội An, and to assess how these preferences vary across beach segments that are impacted differently by processes of coastal erosion. Existing studies focusing on the valuation of beach management programs have mainly been conducted solely on local residents (e.g. Johnston et al., 2018; Landry et al., 2020) or on tourists (e.g. Schuhmann et al., 2016; Marzetti et al., 2016). Some exceptions include Beharry-Borg and Scarpa (2010) and Penn et al. (2017) who have compared the preferences of tourists and residents with a focus on ecosystem quality and beach development. Our study differs by considering various coastal erosion management programs including both erosion protection but also some recreational activities usually provided by a beach. Although previous studies such as Banerjee et al. (2018) and Dribek and Voltaire (2017) have used the CVM, here we use a DCE method which allows a more detailed representation of individual preferences for coastal erosion management policies.

Our study makes four main contributions to the existing literature. First, it is the first study to use a DCE to examine the difference in preferences between residents and tourists for a coastal erosion management policy. Second, we include some recreational activities (facilities with trees and restaurants) as an attribute of a coastal erosion management policy. Third, to account for the fact that coastal erosion in Hội An is not affecting all beach segments in the same way, we implement a split-sample DCE. This approach makes possible to conduct a detailed assessment of individual preferences for each beach segment. Fourth, in the same setting, we consider a wide range of coastal erosion management policies including hard protection measures (groynes, concrete revetment, stair revetment) and soft protection measures (sand bags, beach nourishment). Our results reveal that both residents and tourists are willing to pay a tax to fund coastal erosion management programs in Hội An. However, the two groups express different preferences for the type of protection structure to be implemented and the recreational services to be offered. In particular, tourists express stronger preferences for a pristine and unspoiled beach with trees whereas residents favor activities such as restaurants and trees. Finally, our results suggest that tourists' willingness to pay for coastal erosion management policies is sufficient for the City of Hội An to fund the required investments. Moreover, it is relevant to account for different beach segment when designing erosion management policies.

The paper is organized as follows. Section 4.2 presents a review of the literature. Section 4.3 presents our case study and research questions. In section 4.4, we discuss the design of the choice experiment and methodology. The estimation results are presented in Section 4.5. Section 4.6 provides further discussion and policy implications. Section 4.7 gives brief concluding remarks.

4.2 Literature review

There exists a large panel of policies that can be implemented to mitigate the impact of coastal erosion. The available options can be classified into four categories: structural defence (implementing structures to protect and maintain the coastline), accommodation (maintaining use of the coast while accepting the risk of erosion to a certain degree by changing land use or wetland restoration), coastal retreat (relocating infrastructure inland and away from the eroded beach) and sacrificial zones (presenting no intervention). (Williams et al., 2018; Landry et al., 2020). Structural defence solutions include soft measures (restoring the beach using sand by soft visible intervention such as sandbags or beach nourishment, i.e. bringing sediment or sand from other sources to replace the eroded beach) and hard measures (constructing hard engineering structures such as concrete seawalls, revetments, groyne). Although coastal retreat and sacrificial zones have become popular measures, most of the economic literature has focused on structural defences which are still viewed as the traditional strategy for protecting beaches from coastal erosion.

Most studies valuing beach management programs have relied on SP methods. Studies focusing on preferences of residents for coastal management programs report only a very limited support for implementing hard beach protection structures (Spencer-Cotton et al., 2018; Johnston et al., 2018; Matthews et al., 2017b), an explanation for this result being that hard structures may spoil the natural appearance of the beach. When different programs are proposed to residents to mitigate the impact of coastal erosion, a stronger preference for beach nourishment or beach retreat (relative to hard measures) is often found (Landry et al., 2020). A positive willingness to pay for implementing coastal erosion protection programs is usually reported for most residents (Johnston et al., 2018; Meyerhoff et al., 2021). The valuation of coastal erosion protection programs has been shown to be difficult, particularly due to the negative effects that these structures may have on morphological, hydrodynamic and ecological conditions (Huang et al., 2007).

Since beaches in coastal areas significantly contribute to the development of tourism, numerous studies have been carried out to assess preferences of tourists for management of coastal erosion. Although beach visitors may contribute to funding coastal management policies (Whitehead et al., 2008; Borger et al., 2021), it has been shown that tourists' willingness to pay is highly influenced by their awareness regarding beach erosion (Marzetti et al., 2016). Greater beach width and beach access are the two main dimensions usually valued by tourists when they visit a beach destination (Oh et al., 2010; Christie et al., 2015; Schuhmann et al., 2016). In addition, some heterogeneity in preferences for management of coastal erosion across tourists (for example, by income and country) has been documented (Logar and den Bergh, 2014; Marzetti et al., 2016).

Comparative studies have been undertaken to assess the existence of a discrepancy between preferences of tourists and residents for various coastal erosion management policies. Group-specific preferences have been documented but reveal mixed results. Applying CVM to a beach in the Barbados (Caribbean region), Banerjee et al. (2018) report that tourists are in favor of a wide sandy beach with cultural and aesthetic services such as bars and restaurants, while beach connectivity, length, rules, and regulations of ecosystem services are the priorities of the local population. They show that tourists are more willing to pay for mitigating the impact of coastal erosion than residents. In Djerba (Tunisia), Dribek and Voltaire (2017) find similar willingness to pay for tourists and residents. This can be explained by the low living standards of tourists in Djerba. Rulleau and Rey-Valette (2013), however, find a lower WTP of tourists and day trippers than that of residents for a beach erosion protection program in Languedoc-Roussillon (France), which is attributed to residents' higher attachment to their properties on the coastline.

With respect to the literature, our contributions are twofold. First, we consider a developing country, Vietnam. Previous studies have mainly focused on developed countries (e.g. Landry et al. (2020); Johnston et al. (2018); Huang et al. (2007) in the US, Logar and den Bergh (2014); Marzetti et al. (2016) in European countries, Matthews et al. (2017b); Spencer-Cotton et al. (2018) in New-Zealand and Australia). Thus, our knowledge of valuation of coastal erosion management policies in developing countries remains very limited and restricted to a limited number of countries or regions (e.g. Schuhmann et al. (2016); Banerjee et al. (2018) in Caribbean countries, Borger et al. (2021) in Southeast Asia and Dribek and Voltaire (2017) in North Africa). Second, studies comparing the preferences of tourists and residents have focused on ecosystem quality and beach development for recreation and cultural services (e.g. Beharry-Borg and Scarpa, 2010; Christie et al., 2015), while our research is dedicated to erosion protection management policies which include both protection from erosion and beach recreation. To the best of our knowledge, this is the first time that a DCE is implemented to compare the preferences of tourists and residents for a multi-attribute coastal erosion protection policy. Use of a DCE enables a deeper understanding of the trade-offs between the different attributes of a coastal erosion management policy (Hoyos, 2010; Holmes et al., 2017).

4.3 Coastal erosion in Hội An

4.3.1 A brief presentation of Hội An

Hội An is a city located along the central coastline of Vietnam, with a total population of approximately 98,600 people. Hội An's ancient town has been inscribed on the UNESCO World Heritage List since 1999.[4] According to UNESCO (1999), "Hội An is an exceptionally well-preserved example of a traditional Asian trading port." In addition to its authentic architecture, beaches on its 7km long coastline are regarded as some of Vietnam's most beautiful.

Although the city has historically been engaged in several economic activities, its largest economic sector is currently tourism. Because of its listing as a World Heritage Site, the number of tourists visiting Hội An significantly increased from approximately 160,000 annual visitors in 1999 to 5.35 million tourists in 2019. Tourism and commercial services account for approximately 60% of total municipal revenue [5].

4.3.2 Coastal erosion in Hội An

Hội An is exposed to various climate hazards due to its location at the estuary of a river and on a coastal plain (UN-Habitat, 2014). Coastal erosion has become a serious issue in Hội An: its southern coastline has retreated by about 500 meters between 2004 to 2012, and the northern stretch has been eroding at an alarming rate of 12 meters per year, on average (Viet et al., 2015) (see Figure 5.1). Coastal erosion has caused damage to shore-adjacent hotels, resorts and embankments. The loss of beach area, and the damage caused by ongoing construction has had a negative impact on the tourism industry and on residents' livelihoods.

The issue of coastal erosion is expected to worsen in the coming years. With climate change increasing the magnitude and frequency of storm surges and strong waves, Hội An is expected to face a sea level rise of 5 millimeters per year, and to experience

[4] https://whc.unesco.org/en/list/948

[5] Hội An Department of Statistics, 2014

regular floods (Agence Francaise de Developpement, 2017).

Figure 4.1: Coastal erosion in Hội An between 2004 and 2018

Source: Google Earth images for Hội An beach in 2018. The red line indicates the location of the beach in 2004.

Prevention of coastal erosion is thus an urgent issue for Hội An's authorities. Sand bags have been placed in some segments of the beach but authorities have faced some local resistance due to their visual disamenity. Another measure that has been implemented is the construction of concrete embankments, which provides good protection against erosion. Construction of concrete embankments, however, implies high initial investment costs and may negatively impact on the landscape and recreational activities. According to (Fila et al., 2016), the technical solutions to managing coastal erosion in Hội An may require large investments (around million $8.7-30.2) and substantial maintenance costs (around million $25-48.6 for the next 20 years).

4.3.3 Research questions and hypotheses

Previous studies suggest that there is a willingness to contribute to funding coastal erosion protection programs, both from residents (e.g. Johnston et al., 2018; Meyerhoff et al., 2021) and tourists (e.g. Marzetti et al., 2016; Logar and den Bergh, 2014). We expect similar findings, as elaborated in the following hypothesis:

H1: Both tourists and residents are willing to pay for a coastal erosion protection program in Hội An

In the literature on the valuation of coastal management, it is usually found that respondents have strong preferences for wide beaches (Huang et al., 2007; Landry et al., 2020; Schuhmann et al., 2016) with public access (Oh et al., 2010). Likewise, we test for the existence of the same preferences on locals and visitors to Hội An:

H2: Tourists and residents in Hội An prefer a wide beach with public access.

Applying structural protection is essential for managing coastal erosion. However, visible hard-protection constructions are often not supported by beach users (Huang et al., 2007; Matthews et al., 2017b; Johnston et al., 2018). This may not be the case in Hội An. Using short interviews with residents working on the beach and tourists, Fila et al. (2016) observe that residents understand the urgent need for coastal protection measures along the beach to prevent erosion as it badly impacts tourism, the main source of locals' income. Meanwhile, most tourists coming to Hội An are not aware of the coastal erosion situation beforehand. However, after being informed of these issues, they express deep concern about beach sustainability but also maintain that the sea should still be easily accessible from the beach. This leads to our third hypothesis:

H3: Tourists and residents want the beach to be protected from coastal erosion, but tourists differ from residents because they wish to maintain an easy access to the sea from the beach.

Recreational activities are an important aspect of beach use that attract both local residents and tourists. Various studies have reported that tourists, especially from industrialized countries, have a strong preference for an unspoiled environment (Beharry-Borg and Scarpa, 2010; Christie et al., 2015). In our case, tourists come to Hội An to visit the Old City as a heritage site, and some of them also go to the beach to relax and enjoy the sea. As a result, they may express some preference for a pristine and undeveloped beach with "green" cover (coconut trees). On the contrary, local residents may use the beach with their family or for social events. Enjoying beach facilities such as restaurants or bars may be important for them. The fourth hypothesis to be tested is then:

> H4: Tourists and residents have different preferences for recreational services and facilities provided by the beach. In particular, tourists value more a pristine beach whereas residents have stronger preferences for a beach providing services such as restaurants and bars.

Choice behavior is not only subject to preference heterogeneity, but also explained by scale heterogeneity (Louviere et al., 2002). While the former captures the variation in preferences across respondents, the latter identifies differences in the error variance, which reflects heterogeneity in choice consistency (Vass et al., 2018). Accounting for scale heterogeneity is important, particularly when comparing preferences across groups of respondents, otherwise it will lead to biased welfare estimates (Davis et al., 2019; Mariel et al., 2020). The divergence in choice randomness is driven by many factors, e.g. differences in task complexity (Carlsson and Martinsson, 2008), cognitive ability (Christie and Gibbons, 2011), and prior knowledge about valued goods (Czajkowski et al., 2015). When valuing different coastal erosion management policies, Hội An residents and tourists have different levels of familiarity with the local coastal erosion situation and the level of understanding of the choice task, which underlies the following hypothesis:

> H5: Tourists and residents may have differences in the variance of the error term, expressing different degrees of noise in their choice behaviour

The complex physical erosion process, variation in geographic location, geological condition and variation of beach usage result in different geo-morphological characteristics in different parts of Hội An's beaches (Agence Francaise de Developpement, 2017). The beaches in Hội An can hence be considered a heterogeneous environmental good. We thus specify the following hypothesis:

H6: Preferences of respondents differ across different parts of Hội An's beaches

4.4 Material and methodology

4.4.1 Questionnaire content

The questionnaire's development has thoroughly followed the guidelines proposed by Johnston et al. (2017) and previous studies on the valuation of coastal erosion management policy (Huang et al., 2007; Matthews et al., 2017b). It was developed by a research team in collaboration with Vietnamese coastal erosion specialists.

The questionnaire consists of four parts. The first part is devoted to residents' and visitors' attitudes towards the coastal erosion issue and information about the visitors' trips to beaches in Hội An. This "warm-up" part aims to attract respondents' attention and evaluate attitude heterogeneity (Hoyos, 2010). The second part is the DCE section. The third and fourth parts address demographic questions and respondents' personal economic preferences, respectively.

4.4.2 Design of the DCE

Coastal erosion program attributes

Based on previous multidisciplinary projects on coastal erosion in Hội An and focus group workshops, five attributes are identified to characterize coastal erosion programs in Hội An (see Table 4.1). These five attributes are: protection structures, average beach width, public access, recreational offers and facilities, payment vehicle (see Appendix B).

Table 4.1: Attribute description and attribute level in the DCE

Names	Descriptions	Levels
Protection structures	Type of hard or soft protection structures	No hard or soft structures, Sandbags, Stair revetment, Concrete revetment, Groynes
Average beach width	Beach width at high tide (in meters)	0, 25, 50, 75, 100, or 150
Public Access	Percentage of shoreline with public and free access (%)	0, 25, 50, 75, or 100
Recreational offers and facilities	Type of recreational offers and facilities available	Nothing, Trees, Restaurants, Restaurants and trees
Payment vehicles	Tax for coastal erosion reduction. Residents: Tax paid by each resident in Hội An, from 18 to 60 years old, per year. Visitors: Tax paid by each visitor, 18 years old or older, per each trip to Hội An.	Residents: 0, 50, 100, 150, or 200 (thousand VND) (equal to $0, 2.2, 4.4, 6.7, and 8.9) Visitors: $ 0, 2, 4, 6, 8, 10, or 15

Protection structures This attribute describes the type of protection structure to be built along the coastline to prevent erosion. Some hard structures such as groynes or concrete revetment have already been considered in studies on the valuation of coastal erosion protection (Johnston et al., 2018; Landry et al., 2020). We aim to further explore preferences of respondents by including soft protection structures (sandbags) into the DCE. We then consider four protection structures (sandbags, concrete revetment, stair revetment, groynes) and one additional situation with no hard or soft protection structures. One should note that the three hard protection measures differ in terms of aesthetic impact and on accessibility of the beach for recreative activities. Among the proposed structures, sand bags and concrete revetments are already implemented along some parts of the beach.

Beach width Beach nourishment is a standard policy aimed at mitigating the impact of coastal erosion, and beach width has been considered in a number of studies focusing on coastal erosion management (Huang et al., 2007; Landry et al., 2020; Meyerhoff et al., 2021). Beach nourishment is introduced by proposing an attribute "Average Beach Width" with six possible levels: 0, 25, 50, 75, 100 and 150 meters.

Public access In Hội An, a beach can either be public with free access or private with restricted access to hotel and resort guests. This attribute gives the percentage of the shoreline with public access. Five levels are possible: 0, 25, 50 , 75 and 100%.

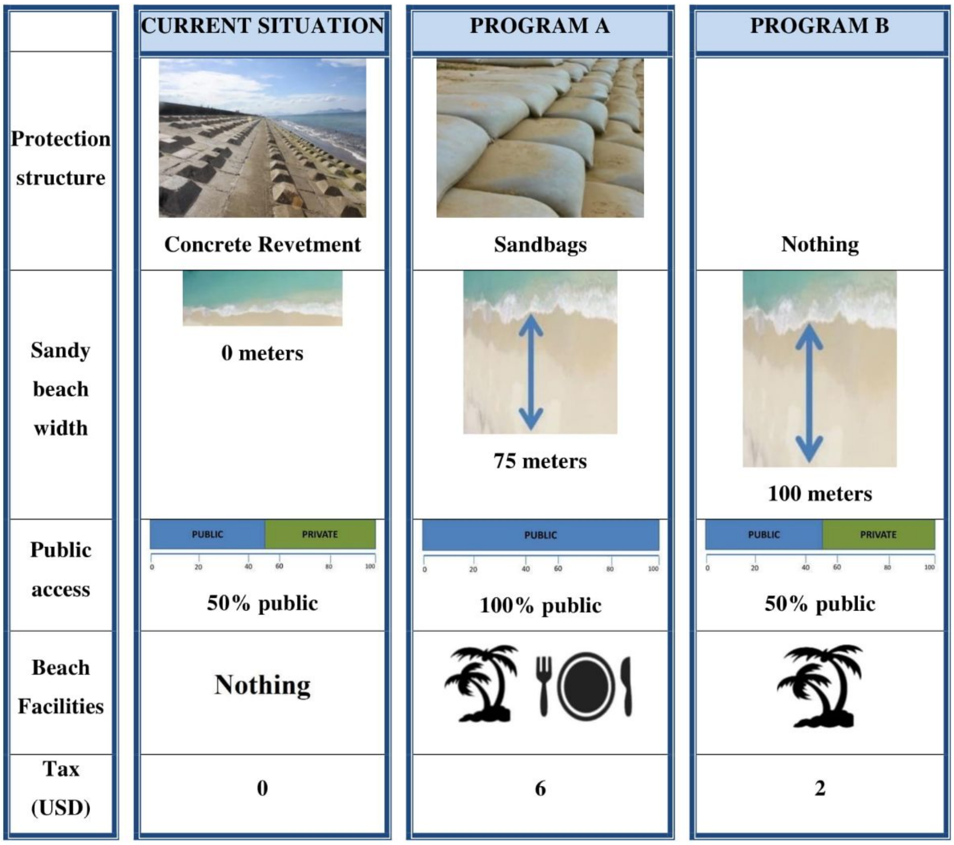
Recreational offers and facilities Previous valuation studies of coastal policies have included recreational activities such as jetting, diving, or snorkeling (Beharry-Borg and Scarpa, 2010; Penn et al., 2017; Borger et al., 2021). Visitors go to Hội An's beaches mainly for relaxing, enjoying the landscape, and spending time at bars and restaurants. Accordingly, our research considers two types of recreational offers and facilities, including trees and restaurants which leads to four levels for this attribute: Nothing, Trees, Restaurants, and Restaurants and Trees.

Payment vehicle Payment vehicle is a crucial attribute for a DCE. The payment vehicle should be realistic and binding for respondents (Johnston et al., 2017). In Vietnam, residents have to pay an annual tax for natural disaster management (Regulation 94/2014/ND-CP, 2014), and the government is considering extending it to tourists. Our payment vehicle is thus both a resident and tourist tax devoted to coastal erosion (see Table 5.1).

Format of choice sets

Binary and multinomial choice set formats have been shown to increase incentive compatibility and reliability of welfare analysis in DCE (Johnston et al., 2017). Each respondent is presented with choice sets in which they are asked to choose between a baseline scenario (at no additional cost) and two scenarios of coastal erosion management programs in exchange for the payment of a tax (see Figure 4.2 for an example of a choice set).

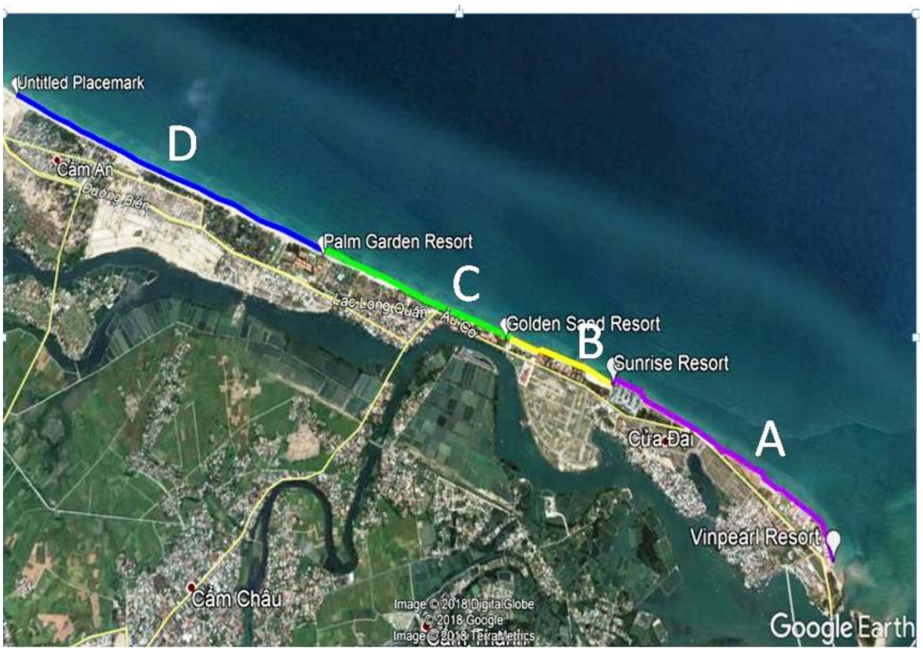
Figure 4.2: Example of choice set



A good understanding of the baseline scenario and of the meaning of the five attributes is a crucial issue (Johnston et al., 2017). In the choice tasks, each level of the attributes are displayed using both the text description and static visualization. Use of visual presentation in the choice questions improves the respondents' understanding of the tasks (Louviere et al., 2000), enhances the tasks' realism and increases respondents' participation (Balcombe et al., 2015). In addition, videos interpreting the attributes and their levels are also shown in the survey, ensuring that the entire survey transmits the same information to all respondents (Appendix C displays the three videos that are shown during the interview). Lastly, to enhance consequentiality and incentive compatibility, and to reduce hypothetical bias, "cheap talk" is used before the choice questions in which respondents are encouraged to carefully consider each coastal erosion management scenario and express their true preferences. After each choice set, a self-reported certainty question using a five-point scale is added. This self-reported certainty question may help mitigate the hypothetical bias (Matthews et al., 2017b). Lastly, two follow-up questions are also presented after the DCE to evaluate the responses' validity, assess the respondents' acceptance of information, and define protest answers (Meyerhoff and Liebe, 2010).

4.4.3 A split sample approach to address Hội An beach heterogeneity

Figure 4.3: Location of the four Hội An beach segments



One specificity of the beaches in Hội An are that they are not homogeneous along the length of the coastline. To account for this characteristic, the beach is divided into four segments (see Figure 4.3). Segment A, located in the south-west, is protected by concrete revetments. In the past, several luxury hotels and resorts have been built in the segment but it now faces severe erosion (beach width has decreased by about 70 to 190 meters since last 15 years). Segment B has lost about 60 to 120 meters of beach width, and is currently not protected by any structures. Segment C was a popular beach in the past, but coastal erosion is now a critical issue there. This segment's beach width has decreased by about 40 meters. It is now protected by sandbags. Lastly, segment D has been essentially stable over the past 10 years, and has no protection structure.

Table 4.2: Current situation of beach segments (Status quo)

Attributes	Beach A	Beach B	Beach C	Beach D
Protection structures	Concrete Revetment	Nothing	Sandbags	Nothing
Beach width (m)	0	25	25	50
Public Access (%)	50	50	50	100
Recreational offers and facilities	Nothing	Trees	Trees and Restaurants	Trees and Restaurants
Payment vehicles (USD)	0	0	0	0

We use a split sample approach in which each respondent has been randomly allocated to one of four beach segments (A, B, C or D). The status quo for each beach segment is described in Table 4.2. A D-efficient design using *Stata* software with priors taken from an estimation of pilot data is used, resulting in 18 choice sets for each segment of the beach. These choice sets are blocked into three versions, each consisting of six choice sets.

4.4.4 Implementation of the DCE

The final survey was organized in July 2018, with a mixed mode of computer-administered and in-person surveys.[6] The survey was transferred to a tablet app version using the XLSform and SurveyCTO applications.[7] This computer-administered survey can provide visual materials, exclude inconsistent answers, decrease implementation costs, and keep researchers updated on survey execution (Champ and Welsh, 2006). The face-to-face survey was conducted by eight interviewers who were all residents of the City of Hội An, and undergraduate students in economics and environmental sciences. The survey was officially approved by the local authorities. Upon the completion of a survey, the visitors received a souvenir and residents received a monetary compensation of VND

[6] A pilot survey was undertaken on a sample of 120 residents and 80 tourists in March 2018

[7] For more information, see https://www.surveycto.com/index.html

40,000 (equal to $1.8). Such incentives might have an effect on the in-person survey's response rate and quality (Singer and Ye, 2012).

399 residents and 200 visitors completed the questionnaire. Convenient sampling was used for visitors who were interviewed in Hội An, including along the river bank, in the Old Quarter, and at the beach. For residents, a stratified random sampling method was used. According to the Hội An administrative division, there are 12 inland communes in Hội An, consisting of 73 villages. The number of interviewed residents in each village was proportional to the ratio of each village's number of residents to the total number of Hội An residents. From Hội An's official list of residents, we randomly extracted names of residents to be interviewed in each village.

4.4.5 Econometric modelling

Data collected in the DCE is analyzed using a MIXL. MIXL allows us to consider heterogeneity in utility weights, heterogeneity of preferences in observed attributes, and flexible variance-covariance structures for the unobserved part of the utility (see, among others, Train, 2009).

Pooled model We first estimate a MIXL model for the pooled sample, assuming similar preferences between tourists and residents. The random utility gained by individual i from choosing program j writes:

$$U_{ij} = \sum_{k=1}^{11} \beta_i^k \times x_{ij}^k + \varepsilon_{ij} \tag{4.1}$$

where x_{ij}^k is a vector of attributes including beach width ($Width$), type of beach protection ($ConcreteRevetment$; $StairRevetment$; $Groynes$; $Sandbags$), type of facilities available at the beach ($Restaurant$; $Restaurant - Tree$; $Tree$), public access ($Access$), the tax to be paid (Tax) and an alternative specific constant if the status quo is chosen by the respondent (ASC) (Scarpa et al., 2005). β_i is a vector of utility coefficients (for observed variables x_{ij}^k) representing individual's tastes, and ε_{ij} is the iid error term. The coefficient vector varies over respondents with a specified density function $f(\beta)$

and is assumed to be independent of the density of ε.

Pooled model with group-specific preferences We then investigate group-specific preferences for tourists and residents by estimating the MIXL model where random utility is specified as

$$U_{ij} = \sum_{k=1}^{11} (\beta_{ir}^{k} \times resident_i + \beta_{it}^{k} \times tourist_i) \times x_{ij}^{k} + \\ (\zeta_r \times resident_i + \zeta_t \times tourist_i) + \varepsilon_{ij} \tag{4.2}$$

The first part of the right-hand side term in Equation (4.2) explores the differences between tourists and residents in terms of mean preferences and in the level of heterogeneity. β_{ir}^{k} and β_{it}^{k} are group-specific random parameters, x_{ij}^{k} are sets of attributes (including ASC), and $resident_i$ and $tourist_i$ are two group-specific dummy variables. The second part of the right-hand side term in Equation (4.2) captures the scale differences between the two groups through an error component approach (Train, 2009). ζ_r and ζ_t are assumed to follow normal distributions with zero means and standard deviations to be estimated. Instead of capturing heteroskedasticity to recognize differences in uncertainty across alternatives (see, among others, Scarpa et al., 2007; Whitehead and Lew, 2020), this component accounts for individual-specific effects since it is included in all alternatives and varies across respondents within each group (e.g. Schaafsma and Brouwer, 2020; Haque et al., 2020). The last element of the right-hand side term in Equation (4.2) is the *iid* extreme value error term ε_{ij}. Using the pooled model with group-specific preferences, we then attempt to control for differences in preference between residents and tourists, preference heterogeneity across respondents and differences in the uncertainty of choice behaviour (noise of utility) between residents and tourists.

4.5 Results

4.5.1 Sample description

In the DCE, 53 respondents (9.9% of the full sample) selected the status quo option for all choice cards that they were presented. Based on a set of follow-up questions after the DCE, we identified 40 protest respondents (39 residents and 1 visitor).[8] Our final sample then consists of 360 residents and 199 tourists.

Table 4.3 presents the socio-demographic characteristics of the two samples. We do not find significant differences between our resident sample and data from the 2018 Vietnam Household Living Standard Survey. Females are slightly over-represented in the tourist sample, which is in contrast to the resident sample. The tourist respondents are generally younger, better educated, and have a higher income than the resident respondents. It can be explained that by using convenient sampling and face-to-face interviews, well-educated tourists are more willing to answer a survey (Marta-Pedroso et al., 2007). One-third of respondents in the resident sample are self-employed. A similar proportion of the tourist sample are either students or private employees. In the tourist sample, 80 participants are Vietnamese citizens, whereas 119 respondents are foreigners coming from 37 different countries. In the resident sample, 45 people live in coast-side wards, accounting for 12.5% of the sample.

Tourists stay in Hội An for an average of 3.4 days. Among them, 70.9% have plans to visit the beaches, compared to 91.4% of residents who visited a Hội An beach last year. There are slight differences between tourists' and residents' reasons for visiting beaches. While tourists visit Hội An beaches mainly for relaxation and landscape, the residents' main purposes are for relaxation and landscape, and swimming. Most residents acknowledge the existence of an issue with erosion (93.1% sample), as do a large, but smaller, share of tourists (60.8% sample). This suggests that coastal erosion

[8] Following Meyerhoff and Liebe (2010); Mariel et al. (2020), protest respondents are the ones who justified their choice of the status quo in all choice cards by one of the following reasons: "I don't think that money will be used effectively", "The City of Hội An should pay", "I don't think that the proposed solution is feasible" and "Only rich people should pay".

is an issue in Hội An that can attract widespread attention.

Table 4.3: Descriptive statistics

	Category	Sample Residents	Sample Tourists	Population
Socio-demographic characteristics of respondents				
Gender (%)	Female	31.9	56.8	34.5[a]
	Male	68.1	43.2	65.5[a]
Age (years)		52.1	29.9	58.3[a]
Education*(%)	High-school graduate & below	71.8	5.5	77.1[a]
	Some college/Professional/University	26	74.4	22.9[a]
	Post-graduate	2.2	19.6	0[a]
Monthly Household Income*(%)	Below $500	62.3	14.3	80.3[a]
	From $500-1000	27.9	17.6	12.8[a]
	From $1000-2000	8.8	22.1	5.8[a]
	From $2000-5000	5.6	7	0.8[a]
	Above $5000	0	19.1	0.3[a]
Profession (%)	Unemployed	1.1	4.5	-
	Self-employed	35.3	7	-
	Government employee	4.7	11.1	-
	Private employee	4.2	35.2	-
	Retired	14.4	1	-
	Students	2.8	33.2	-
	Others	37.5	8	-
Vietnamese Tourists			80 (40.2%)	43%[b]
Foreign Tourists			119 (59.8 %)	57%[b]
Coastline Residents		45		
Other residents		315		
Use of in Hội An beach and knowledge about erosion issue				
Duration of Hội An visit (days)		-	3.4	2.13[b]
Visit beaches in Hội An (% of sample)		91.4	70.9	-
Reason for visiting beach (% of sample)				
	Swimming	61.9	15.6	-
	Relaxing and Landscape	71.4	65.2	-
	Seafood restaurant	16.7	4.3	-
	Working	7.8	-	-
	Others	2.2	14.9	-
Acknowledgement of the erosion issue (% of sample)		93.1	60.8	-
Sample size		360	199	

* % of sample who answers this question
[a] Source: Residents of Hội An in the Vietnam Household Living Standard Survey 2018, data description for the household head.
[b] Source: Hội An Department of Commerce and Tourism, data in 2018

4.5.2 Preferences of residents and visitors for Hội An beach

We first ignore differences across beach segments and consider Hội An's beaches to be a homogeneous environmental good. Models are estimated by the maximum simulated likelihood method using the *Apollo* package in R (Hess and Palma, 2019). All parameters are considered as being random with a normal distribution, with the exception of the tax parameter, which is assumed to be constant (see, for example, Johnston et al., 2015; Schaafsma and Brouwer, 2020). Choice probabilities are simulated using modified latin hypercube sampling (MLHS) with 500 draws (Hess et al., 2006)[9], and to take into account the panel structure of the data. Categorical attributes, including structures and facilities, are dummy coded. A full description of variables is provided in Table D.1 in Appendix D.

[9]We use MLHS instead of Halton draws since it is not recommended to use Halton draws for a model with more than 5 random parameters, due to strong correlation issues (Hess and Palma, 2019)

Pooled model The second column in Table 4.4 presents the results of the MIXL estimation for the pooled sample of tourists and residents. The negative and significant ASC implies that respondents do not favor the current situation of the beach. The positive and significant parameters for "width" and "access" indicate a preference of respondents for a wide beach with public assess. With respect to the protection structures against erosion, estimation results suggest that respondents value a protected beach (Hypothesis H1). It is also shown that respondents express some preference for a beach with a restaurant and trees (or to a lesser extent with only trees). The previous results must be moderated by the significant standard deviation of random parameters for all attributes which indicate heterogeneity in taste across respondents.

Table 4.4: MIXL estimation for Hội An beach

	Pooled model[a]	Pooled model with group-specific preferences		
		Resident	Visitor	Difference
Mean of Random Parameters				
Access	0.011(0.001)**	0.006(0.001)**	0.02(0.003)**	-0.014(0.003)**
ASC	-0.546(0.13)**	-0.482(0.157)**	-0.936(0.222)**	0.454(0.256)*
Recreational offers and facilities (ref. is *Nothing)*				
- *Restaurant*	0.087(0.103)	0.194(0.127)	-0.041(0.182)	0.236(0.229)
- *Restaurant-Tree*	0.555(0.098)**	0.627(0.125)**	0.569(0.161)**	0.058(0.214)
- *Tree*	0.283(0.093)**	0.111(0.116)	0.637(0.164)**	-0.525(0.216)**
Protection structure (ref. is *Nothing)*				
- *Groynes*	0.878(0.111)**	0.816(0.138)**	0.912(0.186)**	-0.096(0.246)
- *Concrete Revetment*	0.677(0.113)**	0.521(0.146)**	0.975(0.185)**	-0.453(0.253)*
- *Stair Revetment*	0.751(0.121)**	0.548(0.157)**	0.904(0.206)**	-0.356(0.283)
- *Sandbags*	0.563(0.114)**	0.55(0.143)**	0.498(0.189)**	0.052(0.253)
Width	0.006(0.001)**	0.006(0.001)**		
Standard deviation of Random Parameters				
Access	-0.015(0.002)**	-0.012(0.002)**	0.019(0.003)**	-0.03(0.004)**
ASC	-1.798(0.13)**	1.656(0.171)**	1.865(0.224)**	-0.209(0.272)
Recreational offers and facilities (ref. is *Nothing)*				
- *Restaurant*	0.74(0.189)**	0.498(0.298)*	0.867(0.272)**	-0.369(0.444)
- *Restaurant-Tree*	0.79(0.152)**	0.772(0.184)**	-0.649(0.273)**	1.421(0.353)**
- *Tree*	-0.509(0.195)**	-0.467(0.221)**	-0.6(0.296)**	0.133(0.324)
Protection structure (ref. is *Nothing)*				
- *Groynes*	0.799(0.208)**	0.342(0.627)	1.153(0.288)**	-0.811(0.987)
- *Concrete Revetment*	1.047(0.179)**	1.186(0.204)**	0.656(0.358)*	0.529(0.398)
- *Stair Revetment*	0.857(0.213)**	1.016(0.258)**	0.666(0.434)	0.349(0.565)
- *Sandbags*	1.128(0.17)**	1.172(0.205)**	1.024(0.276)**	0.148(0.362)
Width	0.004(0.002)*	-0.004(0.002)		
Non-random Parameter				
Tax	-0.115(0.011)**	-0.18(0.017)**	-0.072(0.014)**	-0.108(0.026)**
Standard deviation of Error Component				
ζ	0.254(0.156)	0.31(0.157)**		
Observed choices	3354	3354		
Number of respondents	559	559		
Log Likelihood	-3154.13	-3095.486		
Adj. Rho-square	0.1383	0.1488		
LR test-value		117.28***		
Degrees of freedom		20		

[a] Pooled model with similar preference between tourists and residents
$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Pooled model with group-specific preferences Estimation results are presented in the third and fourth columns in Table 4.4, the last column provides the difference between parameters for residents and tourists. Identification of the pooled model with group-specific preferences requires two additional steps. First, at least one attribute parameter has to be non group-specific (Haque et al., 2020). In our analysis, "width" has been treated as being similar between two groups (we could not reject the null hypothesis that there is no significant difference in preferences for this attribute across respondent groups). Second, error component terms, i.e. ζ_r and ζ_t, had to be estimated for one group and fixed to zero for the other (Hensher et al., 2008). We estimated two models constraining either ζ_r or ζ_t to be equal to zero. Since the variance of the error component was larger for residents than for tourists, we decided to fix $\zeta_t = 0$. It should be stresses that the direct comparison between residents and tourists can then be done using the estimated coefficients from Eq. 4.2 since the scale difference between two groups is taken into account and since both groups took the same DCE questionnaire (Haque et al., 2020).

A first important result is that there is some preference heterogeneity between residents and tourists (the null hypothesis of preference homogeneity is rejected at the usual 5% significance level using a likelihood ratio test).

Second, we find some similarities in the preferences of residents and tourists. As expected, utility decreases with the erosion tax both for residents and tourists. We document however that tourists are significantly less sensitive to the tax than residents. Since average income is lower for residents than for tourists, this finding is consistent with Oh et al. (2010) who find a smaller sensitivity to prices for high income respondents. The positive and significant coefficients for the attributes "access" and "width" reveal that a wide public beach is valued both by residents and tourists (Hypothesis H2). The estimated standard deviations for the random parameters associated with these two attributes are, however, significantly different from zero, suggesting that there is a similar pattern of heterogeneity in the preference for access and width between the two groups. With respect to protection structures, the parameters of the four types of protection structures are significantly different from zero (5% significance level), indicating that both groups prefer a protected beach to an unprotected one (Hypothesis H1). The magnitudes of preferences for different kinds of protection structures are, however, slightly different between residents and tourists. Residents in Hội An place the highest value on groynes, followed by sandbags and stair revetments, and the least value on concrete revetments. It should be noted that the first three types of structures maintain an easy access to the sea. It is, however, surprising to find that tourists support hard protection structures more than than soft ones. These findings confirm the first part of Hypothesis H3, but contradict to the second part.

Third, our results reveal some differences between preferences of tourists and residents. Concerning alternative available facilities, residents value a beach having both restaurants and trees, whereas tourists favor a beach with only trees. Having only a restaurant on the beach increases residents' utility but decreases tourists' utility, although this difference is not significant. Our H4 hypothesis regarding both groups' preference on recreational services and facilities is thus confirmed.

Fourth, estimation results from pooled model with group-specific preferences reveal a significant standard deviation of the error component for utility of residents (ζ_h), indicating a larger uncertainty in the utility of residents compared to tourists. Residents put a lower weight on the deterministic part of utility. Residents' choice thus appears to be more driven by unobserved factors captured by the error term than by the attributes proposed in the choice tasks. This may reflect a higher choice randomness among residents (Hypothesis H5).

4.5.3 Addressing spatial heterogeneity of Hội An beach's segments

Beach segments in Hội An differ in terms of erosion impacts and type of use by local population and tourists. We now investigate how these differences are perceived by respondents.

Table 4.5: MIXL estimation of pooled model[a] for different beach segments

	Beach A	Beach B	Beach C	Beach D
Mean of Random Parameters				
Access	0.009(0.003)**	0.011(0.002)**	0.015(0.003)**	0.013(0.003)**
ASC	-0.571(0.384)	-0.397(0.314)	0.432(0.35)	-0.789(0.41)*
Recreational offers and facilities (ref. is *Nothing*)				
- *Restaurant*	0.295(0.247)	0.244(0.216)	0.172(0.223)	-0.266(0.21)
- *Restaurant-Tree*	0.45(0.226)**	0.801(0.199)**	0.2(0.236)	0.875(0.268)**
- *Tree*	0.207(0.194)	0.281(0.211)	0.243(0.21)	0.457(0.233)**
Protection structure (ref. is *Nothing*)				
- *Groynes*	1.078(0.225)**	0.432(0.246)*	0.151(0.26)	1.778(0.27)**
- *Sandbags*	0.655(0.247)**	0.474(0.259)*	0.035(0.262)	1.084(0.303)**
- *Concrete Revetment*	0.41(0.229)*	0.712(0.286)**	0.502(0.234)**	1.171(0.394)**
- *Stair Revetment*	0.495(0.243)**	0.871(0.276)**	0.388(0.279)	1.288(0.285)**
Width	0.006(0.002)**	0.006(0.002)**	0.008(0.002)**	0.004(0.002)**
Standard deviation of Random Parameters				
Access	0.015(0.004)**	0.012(0.004)**	-0.004(0.008)	0.022(0.004)**
ASC	2.441(0.313)**	1.338(0.234)**	1.492(0.264)**	1.825(0.343)**
Recreational offers and facilities (ref. is *Nothing*)				
- *Restaurant*	0.937(0.36)**	0.801(0.357)**	0.797(0.365)**	0.347(0.407)
- *Restaurant-Tree*	0.966(0.277)**	-0.416(0.436)	-0.341(0.497)	1.127(0.309)**
- *Trees*	0.587(0.4)	0.728(0.256)**	-0.319(0.435)	1.069(0.368)**
Protection structure (ref. is *Nothing*)				
- *Groynes*	0.861(0.372)**	0.747(0.439)*	1.021(0.476)**	0.081(0.457)
- *Sandbag*	1.175(0.376)**	0.955(0.336)**	1.249(0.274)**	1.071(0.399)**
- *Concrete Revetment*	0.12(0.465)	1.621(0.298)**	0.875(0.439)**	1.961(0.666)**
- *Stair Revetment*	0.594(0.472)	1.14(0.349)**	1.146(0.456)**	0.886(0.448)**
Width	0.005(0.003)	0.008(0.003)**	-0.002(0.005)	0.003(0.004)
Non-random Parameter				
Tax	-0.09(0.022)**	-0.152(0.021)**	-0.067(0.022)**	-0.153(0.024)**
Observed choices	834	990	702	828
Number of respondents	139	165	117	138
Log Likelihood	-779.98	-937.03	-657.46	-715.57

[a]Pooled model with similar preferences between tourists and residents
The standard errors in the last column have been obtained using the Delta method (Daly et al., 2012)
$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Pooled model by beach segment Results presented in Table 4.5 point out that while preferences of respondents for width, access and tax are consistent across beach segments, preferences for recreational facilities and protection structures are slightly different. Respondents are in favour of a beach having both restaurant and trees in segment A and B (facing severe erosion), while they are indifferent between facilities for segment C, a popular beach in the past. Meanwhile, in beach D, a beach that still attracts beach visitors, both restaurant and trees and only trees are preferred by residents. With respect to protection structures, respondents support concrete revetment in segment C whereas they may accept any structure in segment A, B and D.

They have the highest utility for groynes in beach A and D, and for stair revetments in beach B. Consequently, hypothesis H6 cannot be rejected.

Pooled model with group-specific preferences by beach segment Results for the pooled model with different preferences between tourists and residents in the four beach segments are reported in Appendix E.1. Likelihood ratio tests confirm that there is no significant difference between the preferences for coastal erosion management of residents and tourists for beach segment D, while preferences for beach A, B and C differ between the two groups.

Both groups express different inclinations for protection structures. In beach A, while residents prefer easily accessible structures (including groynes and sandbags), tourists opt for the three hard structures. Strong and significant differences between the two groups in parameters associated to concrete and stair revetment are shown. In beach B and C, residents and tourists favor different types of defence structures, although only the estimated difference in taste heterogeneity of both groups is significant. For example, residents are indifferent to a given structure in beach C, whereas tourists prefer concrete revetments. Estimation results also indicate a significant dissimilarity in preference heterogeneity between tourists and residents for facilities in segment A, B and C.

Estimated values of the ζ parameters suggest a higher uncertainty in the choice behaviour for residents compared to tourists for coastal erosion policy valuation in segment A and D.

4.5.4 Willingness to pay

Interpretation of the parameter estimated values reported in the previous tables is not straightforward. A more convenient way to interpret the estimation results is to estimate the marginal willingness to pay (WTP) for a change in a particular attribute. Table 4.6 reports then the marginal WTP based on estimation results given in Table 4.4. Confidence intervals are obtained by implementing the simulation technique proposed by Krinsky and Robb (1991).

Table 4.6: Marginal WTP for coastal erosion management policy attributes

	Pooled model[a]		Pooled model with group-specific preferences			
			Residents		Tourists	
	Mean *	% Positive**	Mean *	% Positive**	Mean *	% Positive**
Access	0.091	76.1	0.035	70.08	0.28	85.63
	(-0.12, 0.3)		(-0.073, 0.142)		(-0.145, 0.71)	
ASC	-4.849	37.6	-2.624	38.51	-12.887	31.32
	(-30.814, 20.819)		(-17.732, 12.659)		(-55.541, 30.262)	
Recreational offers and facilities (ref. is *Nothing)*						
- *Restaurant*	0.794	55.12	1.098	65.29	-0.502	48.32
	(-9.765, 11.475)		(-3.444, 5.691)		(-20.325, 19.551)	
- *Restaurant-tree*	4.869	75.69	3.515	78.95	7.872	80.5
	(-6.412, 16.281)		(-3.531, 10.643)		(-7.136, 22.709)	
- *Tree*	2.435	70.74	0.603	59.52	8.822	85.43
	(-4.913, 9.699)		(-3.71, 4.867)		(-5.059, 22.544)	
Protection structure (ref. is *Nothing)*						
- *Groynes*	7.681	86.15	4.548	99.25	12.815	78.45
	(-3.723, 19.218)		(1.432, 7.701)		(-13.546, 39.482)	
- *Concrete revetment*	5.95	73.95	2.94	66.9	13.643	93.06
	(-8.994, 21.067)		(-7.876, 13.882)		(-1.368, 28.829)	
- *Stair revetment*	6.582	80.89	3.085	70.58	12.659	91.32
	(-5.656, 18.962)		(-6.184, 12.461)		(-2.582, 28.076)	
- *Sandbags*	4.956	69.19	3.099	68	7.033	68.71
	(-11.15, 21.249)		(-7.594, 13.916)		(-16.391, 30.729)	
Width	0.051	93.59	0.031	93.36	0.078	93.36
	(-0.003, 0.107)		(-0.003, 0.065)		(-0.007, 0.163)	

[a]Pooled model with similar preference between tourists and residents
*95% confidence interval obtained by simulation technique (Krinsky and Robb, 1991) is reported below the mean
**% of sample has positive WTP

WTP from pooled model. Firstly, the relatively large confidence intervals for WTP indicate a strong taste heterogeneity of respondents. This can be explained by the diversity of respondents in our sample which includes both residents, and domestic and international tourists. However, a large proportion of respondents have a positive WTP, which reveals strong support for the coastal erosion protection policies proposed in the DCE. Secondly, with respect to protection structures, a majority of respondents are willing to pay to have a beach protected by any type of defence. Thirdly, public access is a major concern for respondents: the WTP for a beach with full public access is on average $9.1, a value higher than the WTP for protection structure. Furthermore, we find evidence against a "part-whole bias" for facilities as the sum of WTP on trees and restaurants separately is smaller than WTP on the combination of these two facilities. This could be explained by the fact that respondents, on average, consider restaurant and trees as complements rather than substitutes. Finally, there is still a number of respondents preferring the status quo (37.6%), suggesting that to implement a coastal erosion management program, respondents should be given more information on the coastal erosion issue and on the need to implement efficient mitigation measures. To sum up, results on the WTP for the pooled model reflect some support of respondents for constructing protection structures (whatever the type of coastal defence considered), yet, the beach needs to be at least partially accessible to the public and it must offer a diverse range of facilities.

WTP from pooled model with group-specific preferences. Overall, results of the percentage of the sample that have a positive WTP suggest that a majority of residents and tourists are willing to pay for a coastal erosion management program and that only a small share of respondents prefer the status quo (hypothesis H1).

Both groups of respondents are willing to pay for a wider beach, but residents are willing to pay less than tourists ($0.031 vs $0.078 for one additional meter of beach width). The WTP for an increased beach width in our study is relatively lower than what is found by Whitehead et al. (2008) and Schuhmann et al. (2016) for a beach in North Carolina and Barbados ($0.23 and $1.48 per meter, respectively). In addition, both groups are willing to pay to insure public beach access, while tourists' WTP is higher than locals ($0.28 for one additional percentage of public access for tourists compared to $0.035 for residents). Studies by Oh et al. (2010) also find a similar discrepancy in the WTP for beach access: tourists and residents are willing to pay $6.33 and $2.46, respectively, for additional public access.

With regard to facilities, there is a difference between the two groups. More than half of the tourists are only willing to pay for a beach with either restaurant-trees or only trees, a beach with trees receiving the highest mean WTP and proportion of positive WTP ($8.822 and 85.43%). On the other hand, most residents are willing to pay for a beach with any type of facility, among that, the highest average WTP and percentage of positive WTP are for restaurant-trees ($3.515 and 78.95%), followed by restaurants and then trees. Visitors and residents have slightly different patterns in their WTP for protective structures. Compared to residents, tourists are considerably more willing to pay for coastal defence structures. This shows a consistency in the preferences of residents, where they express an inclination toward not only well-protected but also easily accessible beaches. Contrary to our results, Banerjee et al. (2018) suggest that residents place a higher value on coastal erosion mitigation by infrastructure investment than tourists in Barbados, at approximately $27 compared to $21. Dribek and Voltaire (2017) estimate that both residents and tourists' WTP for the beach erosion control program in Tunisia is approximately $6, which is lower than the WTP for protection structures at the location of our study.

Table 4.7: Marginal WTP for coastal erosion management in beach segments (pooled model)

	Beach A		Beach B		Beach C		Beach D	
	Mean*	%Positive**	Mean*	%Positive**	Mean*	%Positive**	Mean*	%Positive**
Access	0.102 (-0.179, 0.386)	72.26	0.07 (-0.056, 0.198)	81.51	0.224 (0.116, 0.331)	99.96	0.084 (-0.157, 0.327)	71.38
ASC	-6.191 (-50.809, 38.944)	40.76	-2.557 (-17.019, 12.072)	38.36	6.546 (-29.73, 43.243)	62	-5.092 (-24.702, 14.744)	33.8
Recreational offers and facilities (ref. is *Nothing)*								
- *Restaurant*	3.348 (-13.783, 20.678)	62.83	1.638 (-7.017, 10.392)	62.42	2.629 (-16.755, 22.237)	59.17	-1.725 (-5.453, 2.045)	22.68
- *Restaurant-tree*	5.075 (-12.582, 22.936)	67.87	5.258 (0.707, 9.757)	97.16	2.926 (-5.456, 11.213)	71.76	5.776 (-6.328, 18.02)	77.96
- *Tree*	2.351 (-8.377, 13.204)	64.08	1.884 (-5.986, 9.845)	65.19	3.567 (-4.289, 11.334)	77.07	3.036 (-8.45, 14.656)	66.5
Protection structure (ref. is *Nothing)*								
- *Groynes*	12.066 (-3.67, 27.985)	89.37	2.874 (-5.198, 11.04)	71.85	2.334 (-22.489, 27.445)	56.43	11.646 (10.773, 12.53)	100
- *Concrete revetment*	4.575 (2.381, 6.795)	99.95	4.758 (-12.76, 22.479)	66.9	7.522 (-13.759, 29.05)	71.66	7.75 (-13.324, 29.069)	72.47
- *Stair revetment*	5.56 (-5.288, 16.534)	79.57	5.784 (-6.53, 18.241)	77.49	5.852 (-22.016, 34.042)	63.59	8.47 (-1.049, 18.1)	92.72
- *Sandbags*	7.383 (-14.094, 29.108)	71.17	3.159 (-7.157, 13.595)	69.1	0.637 (-29.729, 31.356)	51.32	7.143 (-4.365, 18.783)	84.09
Width	0.066 (-0.027, 0.159)	87.48	0.042 (-0.041, 0.125)	79.16	0.124 (0.064, 0.184)	99.96	0.023 (-0.01, 0.057)	87.03

*95% confidence interval is reported below the mean
**% of sample has positive WTP

WTP and spatial heterogeneity of Hội An beach's segments. Marginal WTPs using the pooled model are displayed in Table 4.7. The particularities of each beach's segment are reflected into the WTP estimates. Respondents have a higher WTP for protection structures in segment A and D, which are the most eroded segment and the most popular segment, respectively. The WTP for facilities differ across beach segments, however, while more than half of respondents have a positive WTP for all types of facilities in beaches A, B, and C, the majority of respondents are not willing to pay for having only trees in beach D. Segment C appears to be quite specific in terms on WTP estimates, with the highest WTP for width, access and trees.

The marginal WTPs from the pooled model with group-specific preferences by beach segment are reported in Appendix E.2. Our results show that tourists exhibit a higher

WTP than residents whatever the beach segment.

4.6 Discussion and policy implications

4.6.1 Main results

Our paper confirms that both residents and tourists are willing to pay for a coastal erosion protection program, which is consistent with the literature (Johnston et al., 2018; Meyerhoff et al., 2021; Banerjee et al., 2018). The hypothesis H1 thus cannot be rejected.

Specifically, both groups lean towards a preference for a wide public beach, confirming the H2 hypothesis. This finding is in line with previous studies reporting that respondents express a strong preference for large sandy beaches (Huang et al., 2007; Matthews et al., 2017b) without any access restrictions (Oh et al., 2010; Schuhmann et al., 2016).

With respect to protection of beaches against erosion, the first part of H3 is confirmed since both groups value a protected beach. However, we reject the second part of this hypothesis since tourists place a higher value on the construction of hard protection structures, while residents value groynes more, which preserve the accessibility of the sea. This conclusion differs from previous studies reporting that respondents have a tendency to dislike visible protection structures (Huang et al., 2007; Matthews et al., 2017b; Spencer-Cotton et al., 2018). An explanation could be that erosion at Hội An beaches is an urgent threat that requires implementation of more drastic protection measures than only beach nourishment. This shows that, in the context of severe beach erosion, people care more about the protection of the coastline than the preservation of natural aesthetics.

Regarding preferences for recreational facilities, H4 cannot be rejected and this result reflects some discrepancies between two groups of respondents. Residents are, for instance, only willing to support a beach with trees and restaurants, whereas tourists prefer to support a beach with only trees. This finding is consistent with previous empirical studies reporting that non-resident tourists prefer a pristine and unspoiled beach (Beharry-Borg and Scarpa, 2010; Christie et al., 2015). This result can also be related to the fact that tourists come to Hội An mainly to visit the old city center, which is listed as a UNESCO World Heritage site. Tourists typically stay in the old city center where they can enjoy various cultural activities. They usually go to the beach for only a couple of hours to relax and swim.

Using an error component mixed logit model, the estimation results confirm the H5 hypothesis by finding a higher noise in utility in the resident group. The randomness in choice behaviour reflected in the unobserved part of utility could be explained by the level of respondents' education and cognitive ability of respondents (Christie and Gibbons, 2011), prior experience, information and knowledge of the valued goods (Czajkowski et al., 2015). The statistical description of the surveyed sample indicates a lower number of respondents having a tertiary degree, but a higher portion of respondents acknowledging the problem of coastal erosion in Hội An, in resident sample than in tourist sample (28.5% vs 94.8% and 94% vs 60%). Consequently, we can conjecture that residents tend to make their choices rather using their prior information and experiences than analyzing in the DCE in detail. In addition, due to the task complexity, residents may find it more difficult than tourists to interpret choice cards and answer questions based on well-defined preferences.

Finally, our results confirm that it is relevant to account for the particularities of beach segments, which confirms H6. In addition, while tourists and residents express similar views regarding segment D (currently the most popular part of Hội An beach), our DCE reveals different preferences for the three other segments. This finding is consistent with Logar and Brouwer (2018) and Penn et al. (2017) who find a variation in preferences across sub-regions for river restoration and coastal water quality settings. However, it contradicts Spencer-Cotton et al. (2018), who report that preferences for coastal management are similar irrespective to coastal sub-regions. This reflects that the current state of beach segments in Hội An is perceived differently by respondents.

4.6.2 Policy implications for Hội An

Our findings raise some policy issues, which we will discuss in this section. First, our study suggests that Hội An city could raise money from tourists to fund protective structures for mitigating coastal erosion. In 2019, the City submitted a request for a $30 million fund to the Vietnamese Government to be able to invest in coastal erosion protection measures. With about 5.35 million tourists having visited Hội An in 2019, our WTP estimates indicate that the City could raise a budget up to approximately $37.6 million from tourists for protection structures (compared to only $289,884 by applying our WTP estimates to approximately 98,600 residents living in Hội An). The amount of money to be collected from a tax on tourists is substantial and in line with city expenses dedicated to coastal erosion mitigation. The relevance of a tourist tax devoted to coastal management has been confirmed in other studies. Blakemore and William (2008) and Christie et al. (2015) have indeed proposed an ecotax and a tourist tax, respectively, as effective policy tools that can be applied on tourists.

Second, in the context of a tourist site facing the critical issue of erosion, as is the case in Hội An, an efficient coastal management policy strategy could be to combine beach nourishment with the construction of a protective structure. Beach nourishment is also supported by previous studies (Whitehead et al., 2008; Johnston et al., 2018). Moreover, since various types of structures are all supported by respondents, authorities should conduct further technical research and cost-benefit analyses to select the most suitable defence.

Third, there are divergent interests among tourists and residents regarding beach facilities. Tourists have the highest preference for an undeveloped, pristine beach, while residents prefer a beach with both restaurants and trees. A way to reconcile these different views could be to provide different types of facilities across Hội An beach segments. According to our results, coconut trees should also be planted along the beach to create a "green" look for the beach, which may improve the beach's attractiveness and its relaxing appearance.

Fourth, our results suggest that authorities in Hội An should limit the private share of beaches. The WTP for public beach access might be an insight for policy-makers wishing to set an access fee to fund beach management policies. Beaches with an access fee tend to offer better facilities and a higher quality experience, providing more consumer surplus for visitors (Logar and den Bergh, 2014).

Finally, different management programs should be applied to different beach segments. Due to its popularity, An Bang beach (segment D), should receive more attention regarding protection against erosion even though it has not yet faced significant erosion. The development of an intra-site management plan is thus needed (Beharry-Borg and Scarpa, 2010) for Hội An's beaches.

4.7 Conclusion

We have contributed to the existing literature by comparing preferences of tourists and residents for multi-attribute coastal erosion management programs in Hội An, a touristic destination in Vietnam which has been dramatically affected by coastal hazards. Although our estimation results reveal similar preferences for a wide public beach across the sample, they indicate several discrepancies among the two groups of respondents, in particular for protection structures and recreational facilities. Our results also suggest that it is appropriate to apply different management policies on different parts of the beach.

A few potential extensions of our work should be mentioned. First, while we have characterized the preferences of tourists and residents for different protection structures, additional work on cost-benefit analyses should be conducted in order to identify the most relevant coastal erosion protection policies. Moreover, Perni et al. (2020) emphasize the influences of institutional trust on respondents' choice of policy instrument. In our survey, some respondents have expressed concern that the money dedicated to coastal erosion may not be used effectively. Thus, although a tourist tax has been suggested as an effective payment mechanism, it is essential to conduct additional studies on the acceptability of such a policy instrument.

Chapter 5

Integrating multi-directional spatial patterns for valuing a coastal erosion management policy

5.1 Introduction

Expanding literature has paid attention to spatial heterogeneity in stated preference valuation (Glenk et al., 2020). The reason is information on spatial distribution of values is needed to ensure the reliability of value transfer and benefit aggregation (Valck and Rolfe, 2018). Moreover, ignoring to account for spatial pattern of values might cause a biased estimation and a failure to capture welfare heterogeneity, leading to inefficient policy recommendation (Johnston et al., 2015; Glenk et al., 2020). Firstly introducing in seminal works by Sutherland and Walsh (1985); Anselin and Getis (1992), spatial patterns have been tested in different settings. For example, it is found that values increase with the closer distance of respondents' location to the environmental goods (known as "distance-decay effect") in forest management (Czajkowski et al., 2017), river restoration (Logar and Brouwer, 2018), ecosystem services (Olsen et al., 2020), water quality improvement (Johnston et al., 2017), marine life protection (Brouwer et al., 2016). On the other hand, in the valuation of iconic environmental goods such as Great Barrier Reef (Rolfe and Windle, 2012) or public goods that produce mostly non-use value (Loomis and White, 1996; Bulte et al., 2005), the effect of distance on values is weak.

In the context of coastal erosion management, there is a strong base of hedonic pricing model on spatial-dynamic externalities among the local population on beach nourishment (Landry et al., 2020). It is pointed out that the spatial feedback between two neighboring coastal communities under a decentralized coastal erosion management leads to "suckers"[1] and "free riders"[2] (Williams et al., 2013). The necessity of government intervention at a larger scale is thus suggested (Gopalakrishnan et al., 2017, 2018). However, there are very limited Stated Preference (SP) studies addressing spatial patterns of valuation on coastal erosion protection. On that focus, Luisetti et al. (2011) find an evidence on unidirectional distance-decay effect for coastal managed realignment, which could be explained by the higher flooding risk that population living closer to the

[1] A town has to nourish more due to the loss of sediment to its adjacents

[2] A town plans to nourish less thanks to the spillover benefit from its adjacents

coastline is facing. On the other hand, Ardeshiri et al. (2019) find mixed results across different respondent groups. Moreover, there is an evidence that utility is not always monotonically diminished in all direction (Schaafsma and Brouwer, 2013; Johnston et al., 2015).

Therefore, our objective is to explore spatial patterns of values for a coastal erosion management program and whether the estimates are bias if we ignore the multi-directional spatial patterns. Our variable of interest is respondents' valuation for the implementation of coastal erosion management programs. Thus, we make use of distance decay effect by including a multi-directional distance function in the utility function. Then we illustrate our results by visualizing willingness to pay (WTP) for implementing coastal erosion management programs for unsampled population in Hội An using GIS data and kriging technique.

Our paper has two main contributions. First, it adds to the limited literature on spatial heterogeneity of valuation on coastal erosion management by introducing a complex spatial pattern through multi-directional variation of WTP. Second, by the setting of split-sample, we can observe the spatial variation of WTP for implementing management programs across four adjacent beach segments and whether it is related to spatial dynamic erosion process.

The paper is organized as followed. A brief literature review on spatial heterogeneity and distance-decay effect is given in Section 5.2. Section 5.3 introduces the case study and the methodology. Results are presented in Section 5.4. Section 5.5 delivers a discussion of results and it draws some policy implications. Section 5.6 concludes.

5.2 Literature Review

5.2.1 Spatial heterogeneity

A literature review on spatial heterogeneity in stated preferences is thoroughly provided by Glenk et al. (2020) and Valck and Rolfe (2018). It is the variation of values for environmental goods/services across space with a spatial pattern (Glenk et al., 2020; Czajkowski et al., 2017). There are several reasons for it: the availability of substitutes, respondents location and residential sorting, spatial distribution of respondents' socio-demographic characteristics and the fact that welfare decreases with distance. The issue of spatial heterogeneity is important for the reliability of value transfer and benefit aggregation (Valck and Rolfe, 2018) and the capture of welfare heterogeneity which promotes efficient policy recommendation (Johnston et al., 2015; Glenk et al., 2020).

In order to control for spatial heterogeneity, there are two main empirical approaches that have been followed in the literature. The first family is the incorporation of the spatial variable as an exogenous variable in the utility function, allowing to capture the observable spatial heterogeneity. This method is widely known as "distance decay function". The explanatory ability of the model can be improved and the omitted variable bias is decreased under the inclusion of spatial variables (Glenk et al., 2020). The second family is the capture of spatial dependence through different types of spatial clustering by the techniques of geo-statistical and spatial econometric. This type is likely to detect unobserved spatial heterogeneity rather than pointing out a specific source of heterogeneity. From a theory perspective, the former type is often consider to have a strong link to microeconomics theory. On the other hands, studies using spatial econometric, despite of being less informed in economic theory, are able to provide new interpretation of spatial patterns. Connection and harmonizing of both categories are suggested to be of interest for future research (Holland and Johnston, 2017).

5.2.2 Distance decay effect

Accounting for spatial factors in valuation of environmental goods involves identifying the geographical limit of valuing population, the geographical area of interest and the substitutes availability (Valck and Rolfe, 2018). These different issues are directed to the context of distance decay effects, i.e. the value for environmental goods decreases with increased distance (Pate and Loomis, 1997).

Literature points out several reasons that contribute to the distance decay effect:

an increase of cost to access (Bateman et al., 2006; Hanley et al., 2003), the feeling of being less responsible (Johnston and Duke, 2009) and a lower level of cognition of the environmental goods for people who live in further distances (Sutherland and Walsh, 1985), and the availability of substitutes that increases with distance (Schaafsma and Brouwer, 2020; Logar and Brouwer, 2018).

The degree of distance decay effect is influenced by type of values, target population, characteristics of goods, the form of distance, the framing of scenario and distance-decay functional form (Glenk et al., 2020; Valck and Rolfe, 2018). Distance decay effect is mostly found for use values, while expresses mixed results for non-use values. For example, Schaafsma and Brouwer (2013); Jorgensen et al. (2013) show a significant distance decay effect for non-use values in water recreation sites and water quality improvements, while in Bulte et al. (2005); Johnston et al. (2015), no distance-decay effect is confirmed for non-use values. Moreover, concerning a different group of respondents, Hanley et al. (2003); Schaafsma and Brouwer (2013) imply a higher distance-decay rate in the user than non user while Lizin et al. (2016) find no evidence of the difference. Logar and Brouwer (2018) suggest a stronger distance-decay effect of respondents living in rural areas compared to urban areas. Distance decay effect is found to be weak for the goods that are widely considered as iconic and important with few available substitutes, for example, Great Barrier Reef (Rolfe and Windle, 2012) and threatened marine species (Johnston et al., 2015).

Two common types of measuring distance are commonly considered in capturing spatial heterogeneity. Travel distance is suggested to be more suitable in a study at local and regional level (e.g. Logar and Brouwer, 2018; Jorgensen et al., 2013), while Euclidean distance (e.g. Holland and Johnston, 2017) should be used in the case that deriving values is not necessary from assessing to the goods (Glenk et al., 2020).

Distance decay effect also varies according to the type of functional form. Traditionally, distance is commonly specified as linear and monotonic, however, it is found that WTP is not always homogeneously declined in all directions (Rolfe and Windle, 2012; Johnston et al., 2015). The need of a more advanced approach is suggested to capture the complex spatial patterns (Holland and Johnston, 2017; Johnston and Ramachandran, 2014). In order to control the diversity of spatial variation, the usage of multi-directional distance variables has recently been included in some studies (Logar and Brouwer, 2018; Schaafsma and Brouwer, 2013). With respect to the model specification of distance, different function are used, including parametric (Bateman et al., 2006; Pate and Loomis, 1997), semi-parametric by quadratic (Hanley et al., 2003) or non-parametric by using Generalized Addictive Model (GAM) model. GAM model, combined with the use of GIS data, allows a spatial pattern directly from data by a smoothing term. It is applied in spatial dependence analysis as a kriging technique to drive a cluster map which captures spatial distribution (Czajkowski et al., 2017). However, it is still rarely used on distance-decay studies (see, for all, Ferrini and Fezzi, 2012; Andrews et al., 2017; Olsen et al., 2020).

In this study, we make use of the distance decay effect: first we use a multi-directional distance decay function to capture the spatial variation in preferences. Then, from estimation results, we derive a map of the spatial distribution of WTP using kriging method and the GIS data. By using that method, we are likely to account for observed spatial heterogeneity and predict values for out-of-sample residents. In addition, while other studies explore spatial heterogeneity in different settings, we analyse the spatial pattern of valuation on coastal erosion management programs that has rarely been addressed before. Due to the spatial dynamic interaction of the coastal erosion process across adjacent beach segments, the spatial pattern of valuation for a coastal erosion management is expected to be complex and vary along the coastline.

5.3 Materials and methods

5.3.1 Coastal erosion in Hội An

Hội An is located along the coastline in the central part of Vietnam. Its ancient town has been inscribed as a UNESCO World Heritage site since 1999 [3]. Cua Dai beach, a

[3] https://whc.unesco.org/en/list/948

part of Hội An is listed as one of the most beautiful beaches in Vietnam.

In recent years, erosion has occurred severely on Cua Dai Beach to an extent that sandy beaches have disappeared in some areas and shore adjacent buildings are threatened (Figure 5.1). The southern end of the beach has substantially changed in last 13 years and the shoreline position has retreated by about 500 meters. The situation is different in northern stretch since the sandy beach is still presented but is eroding at a high rate (12m/year on average) (Viet et al., 2015).

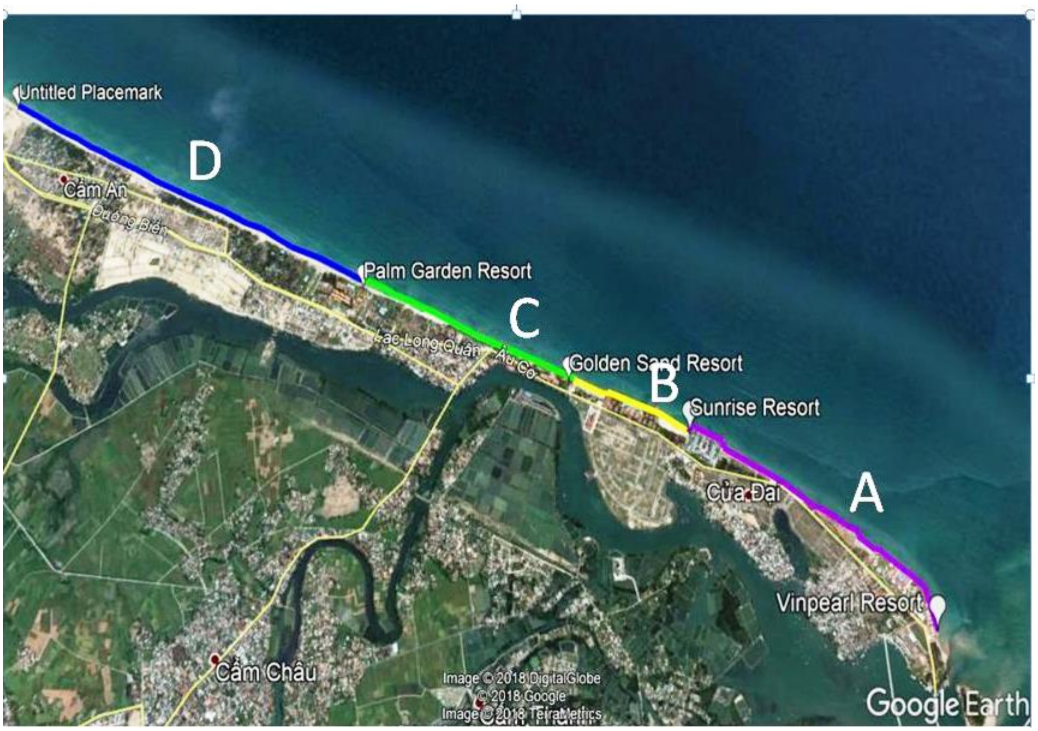
Figure 5.1: Erosion problem in Hội An beach (2004-2018)

Source: Google Earth

There are several contributors to the recent erosion rate: sea level rise, increase of storms frequency, reduction of sediment supply in the upstream river due to sand mining and dam construction, and natural variation (Agence Francaise de Developpement, 2017). In terms of economic impacts, the problem of erosion is twofold. One side is the increasing threat to hotels and resorts built along the beach. Their amount of investments and the proximity to the sea makes beach erosion a big problem. The other side is the loss of an attractive landmark for tourismreducing an important income resource for the city. To alleviate and stop structural erosion of the Cua Dai Beach in Hội An, various technical solutions have been proposed and applied, including concrete revetment and sandbags.

The process of coastal erosion is not homogeneous along the coastline in Hội An. Four beach segments can be distinguished depending upon past intensity of erosion and measures taken by public authorities to mitigate impacts (Figure 5.2).

Figure 5.2: Location of the four Hội An beach segments



Segment A, 2 kilometers long of coastline, is the place where several luxury hotels and resorts have been built in the past. It has faced severe erosion that causes the loss of about 70 to 190 meter of beach width since last 15 years, and is now protected by concrete revetment. Segment B, 0.9 kilometers of beach, has lost about 60 to 120 meters of beach width in the last 15 years. This part of the beach is currently not equipped with any kind of protection structure. Segment C, 1.7 kilometers long, was a popular beach in the past but it is now in an urgent situation of coastal erosion that has decreased about 40 meters of beach width. Segment D, a 3 kilometer beach, has faced moderated erosion in the past 15 years and there no protection structure in this segment.

5.3.2 The choice experiment

Discrete choice experiment is an experiment where presenting a list of scenarios for a valued good including both the current situation and hypothetical changes which are called "alternatives". Each scenario is characterised by a specific list of characteristics, called "attributes". Respondents have to choose one of alternatives (Train, 2009; Holmes et al., 2017). By using a discrete choice experiment, we want to assess residents' tradeoff when selecting different coastal erosion management programs. These programs present both the ability for coastal conservation and beach recreational feature.

Based on previous multidisciplinary projects on coastal erosion in Hội An, focus groups meeting and pilot survey, five attributes are identified to characterize a coastal erosion program in Hội An (see Table 5.1). These five attributes are: (1) protection structures, (2) average beach width, (3) public access, (4) recreational offers and facilities, and (5) payment vehicle. A video interpreting attributes and their levels is conveyed in the survey, ensuring that all the survey will transmit the same information.

Payment vehicle is a crucial attribute for a choice experiment. Payment method should be realistic and binding for respondents (Johnston et al., 2017). In Vietnam, residents annually have to pay an additional fee for natural disaster management (Regulation 94/2014/ND-CP, 2014). In this study, household tax are selected as payment vehicle.

Regarding the valuation response formats, binary and multinomial choices allow increased incentive compatibility and reliability to welfare analysis (Johnston et al., 2017). We apply multinomial format in our choice experiment given that each choice set includes two treatment alternatives and the current situation of beach (status quo).

Figure 5.3 gives an example of choice set. In order to give clear information of a choice set, each level of all attributes was displayed using both text description and static visualization.

Table 5.1: Attribute description and attribute level for the choice experiment

Names	Descriptions	Levels
Protection structures	Type of hard or soft protection structures to fight against and prevent erosion	No hard or soft structures Sandbags Stair revetment Groynes Nothing
Average beach width (in meters)	Average width of the beach at high tide (in meters). Compared to the current situation, the width is increased by a technique solution called beach nourishment, which adds more sand to beach.	0, 25, 50, 75, 100, 150
Public Access	Percentage of the beach with public access and totally free access to all people	0 25 50 75 100 (%)
Recreational offers and facilities	Type of recreational offers and facilities presented in the beach	Trees Restaurants Restaurants and trees Nothing
Payment vehicles	Tax paid by each resident in Hội An (from 18 to 60 years old) each year.	0 50 100 150 200 VND (equal to $0 2.2 4.4 6.7 8.9)

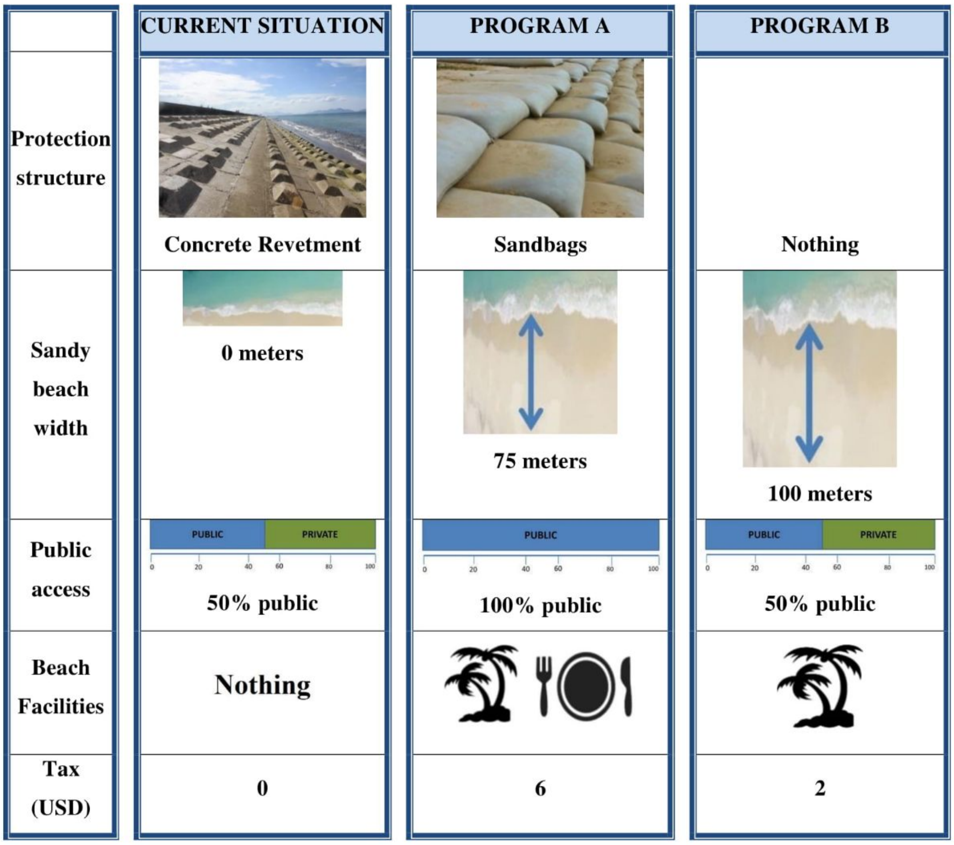
5.3.3 Modeling of individual choices in the DCE

The modeling of individual choices in the DCE relies on a mixed logit model (MIXL). A MIXL model allows preferences to vary across individuals (Train, 2009). Our baseline specification corresponds to the standard mixed logit model where all attributes contribute in a linear way to individual utility. In this framework, the utility individual i obtains from alternative j in choice occasion t is defined as:

$$\begin{aligned} U_{ijt} = \; & \beta_{1i} \times ASC_{ijt} + \beta_2 \times Tax_{ijt} + \\ & \beta_{3i} \times Access_{ijt} + \beta_{4i} \times Width_{ijt} + \beta_{5i} \times Sandbags_{ijt} + \\ & \beta_{6i} \times ConcreteRevetment_{ijt} + \beta_{7i} \times StairRevetment_{ijt} + \beta_{8i} \times Groynes_{ijt} + \\ & \beta_{9i} \times Tree_{ijt} + \beta_{10i} \times RestaurantTree_{ijt} + \beta_{11i} \times Restaurant_{ijt} + \epsilon_{ijt} \qquad (5.1) \end{aligned}$$

A description of variables is presented in the Appendix D. A common practice in DCE is to introduce an alternative specific constant (ASC) into the specification of the utility,

Figure 5.3: Example of choice set in the DCE



in order to capture some unobservable influences beyond attributes present in the choice sets. Here, ASC_{ijt} is a dummy variable equal to one if respondent i opts for the current situation in a given choice set t, and to zero otherwise. ASC_{ijt} may then capture a specific preference for the status quo (Meyerhoff and Liebe, 2010).[4] Tax corresponds to the tax paid by each resident each year for funding coastal erosion management programs. The categorical attributes including structures and facilities are dummy coded, where the presented attribute level is 1 and the other levels are 0. All utility parameters including those of ASC are assumed to be normally distributed, except the tax utility parameter which is non random. ϵ_{ijt} is idiosyncratic error term and assumed to be i.i.d. extreme value.

[4]Other interpretations of a significant ASC include the presence of a status quo bias, mistrust in the instituion in charge of implementing the proposed programs, complexity of the choice tasks, or protest against the survey (Meyerhoff and Liebe, 2010).

In our second specification (MIXL model with unidirectional distance), we introduce an unidirectional distance decay function into the individual utility. There are different ways for introducing distance into the utility function. Distance can be added as an independent variable in the utility function (e.g. Schaafsma et al., 2013) or it can be interacted with the choice attributes as in Schaafsma et al. (2012) or with the status quo as in Rolfe and Windle (2012); Logar and Brouwer (2018). Distance can also be considered as a factor explaining class membership in a latent class approach (Czajkowski et al., 2017). Here we are interested in understanding the effect of respondents' location on their preferences for implementing a coastal erosion management program .i.e. from moving away from the status quo. Thus, we follow Rolfe and Windle (2012) and Logar and Brouwer (2018) by assuming that distance is introduced into the utility by modifying individual specific preferences for the status quo. More specifically, the utility function incorporating the unidirectional distance decay function is specified as follows:

$$\begin{aligned} U_{ijt} &= \beta_{1i} \times ASC_{ijt} + \beta_d \times Distance_i \times ASC_{ijt} + \\ &\quad \beta_2 \times Tax_{ijt} + \beta_{3i} \times Access_{ijt} + \beta_{4i} \times Width_{ijt} + \beta_{5i} \times Sandbags_{ijt} + \\ &\quad \beta_{6i} \times ConcreteRevetment_{ijt} + \beta_{7i} \times StairRevetment_{ijt} + \beta_{8i} \times Groynes_{ijt} + \\ &\quad \beta_{9i} \times Tree_{ijt} + \beta_{10i} \times RestaurantTree_{ijt} + \beta_{11i} \times Restaurant_{ijt} + \epsilon_{ijt} \qquad (5.2) \end{aligned}$$

where $Distance_i$ is the travel distance from house of respondent i to the valued beach. In the previous equation, the parameter β_d measures how distance to the beach impacts on the utility associated to the status quo. A positive coefficient means that the further away from the beach a respondent is located, the higher is the utility from the status quo and so the lower is his/her willingness to pay for implementing a coastal erosion management program. We consider here the biking distance to the beach since bicycles and motorbikes are more relevant than cars as they are the most common forms of transport in Hội An where roads are small. We divided each beach segment into 10 points and take the distance to the point closest to respondent's house. The travel distance is calculated using OpenStreetMap database with the GIS data of respondents' house locations.

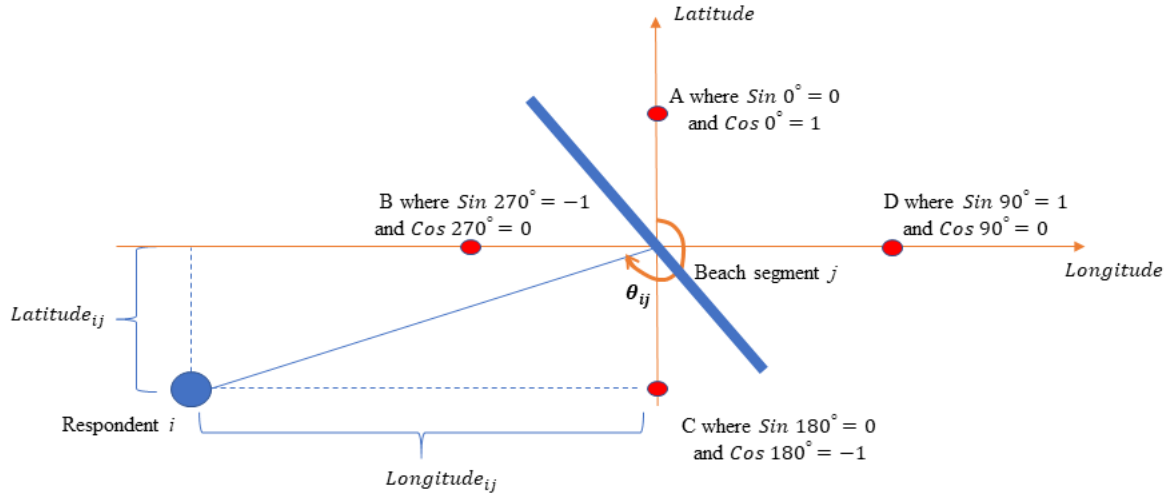


Figure 5.4: Multi-directional distance function

When preferences vary over space in a complex manner, ignoring the presence of directional heterogeneity in distance may result into biased estimates (Logar and Brouwer, 2018; Olsen et al., 2020). Our third specification makes use of the multi-directional spatial heterogeneity approach suggested by Schaafsma and Brouwer (2013); Logar and Brouwer (2018) as an expansion from Cameron (2006). Multi-directional heterogeneity occurs when the effect of distance on valuation varies across different directions rather than being the same within all directions. The multi-directional distance-decay function for respondent i is as follow:

$$\begin{aligned} f_i(x, y) \quad = \quad & \beta_d \times Distance_i + (\phi_1 \times Longitude_i + \phi_2 \times Latitude_i) + \\ & (\varphi_1 \times \cos\theta_i + \varphi_2 \times \sin\theta_i) \end{aligned} \tag{5.3}$$

$Longitude_i$ and $Latitude_i$ are the longitudinal and latitudinal Euclidean distances from the house of respondent i to the valued beach.[5] These parameters indicate

[5]Longitudinal, latitudinal distance and the angle θ_i is computed by package *Geosphere* in *R* (Hijmans et al., 2019).

how the distance decay effect is different from the east to the west, and the north to the south of the beach. θ_i reflects the angle between the direction starting from the valued beach to the home location of respondents and the direction to the north, clockwise. The parameters of cos and sin variables capture the preference differences between respondents living in the north and south, and the east and west, respectively. Interpretation of these variables is visualised in Figure 5.4. The utility function with the multi-directional distance decay function is specified as following:

$$\begin{aligned} U_{ijt} &= \beta_{1i} \times ASC_{ijt} + f_i(x,y) \times ASC_{ijt} + \\ &\quad \beta_2 \times Tax_{ijt} + \beta_{3i} \times Access_{ijt} + \beta_{4i} \times Width_{ijt} + \beta_{5i} \times Sandbags_{ijt} + \\ &\quad \beta_{6i} \times ConcreteRevetment_{ijt} + \beta_{7i} \times StairRevetment_{ijt} + \beta_{8i} \times Groynes_{ijt} + \\ &\quad \beta_{9i} \times Tree_{ijt} + \beta_{10i} \times RestaurantTree_{ijt} + \beta_{11i} \times Restaurant_{ijt} + \epsilon_{ijt} \end{aligned} \tag{5.4}$$

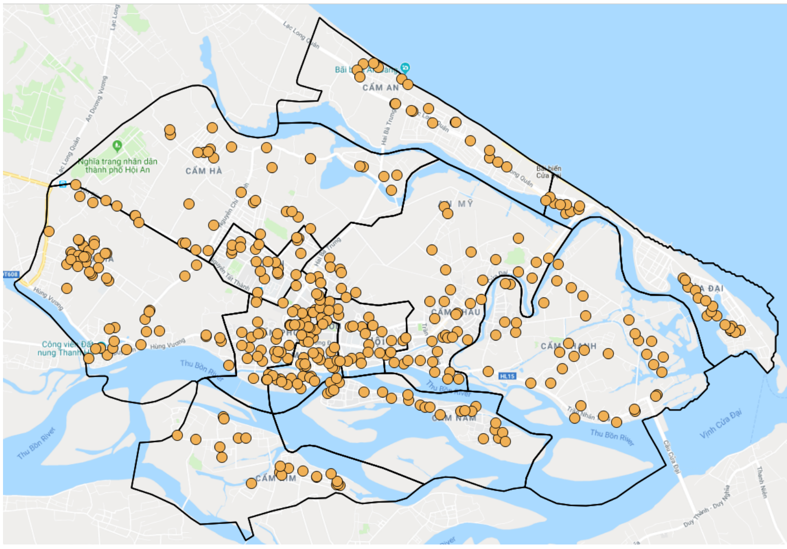
In what follows, the usage of these three specifications allows us to explore which form of spatial heterogeneity is more appropriate in the valuation of a coastal erosion management program.

5.3.4 Implementation of the DCE

Sampling A pilot survey was undertaken on a sample of 120 households in March 2018, while the final survey was organized in July 2018resulting in a sample of 399 households. Stratified random sampling was used. According to Hội An administrative division, there are 12 inland communes in Hội An which consists of 73 sub-communes. The number of interviewed households in each village is proportional to the ratio of each village's number of households over the total number of Hội An households.[6] The list of interviewed households was randomly extracted from a full list of household that is provided by Department of Population of each commune. Figure 5.5 presents the location of our sample.

[6]Data on number of households is from Hội An statistical yearbook in 2016

Figure 5.5: Location of interviewed households



Split sample approach The Hội An beach can be divided into four distinct segments based on the erosion rate and the protection structures. We have then designed a choice experiment for each segment using a split sample approach in which each respondent has been randomly assigned to a particular beach segment. For each beach segment, the same D-efficient design has been used (priors from pilot data), resulting in 36 alternatives for each beach segment. All of them have been blocked into 3 versions which consist of 6 choice sets. Since the four beach segments have been impacted by erosion in different ways, the status quo is then specific to each beach segment (see Table 5.2).

Table 5.2: Current situation of beach segments

Attributes	Beach A	Beach B	Beach C	Beach D
Protection structures	Concrete Revetment	Nothing	Sandbags	Nothing
Beach width (meters)	0	25	25	50
Public access (%)	50	50	50	100
Recreational offers and facilities	Nothing	Trees	Trees and Restaurants	Trees and Restaurants

Survey implementation The survey was conducted in a mixed mode of both computer-administered and in-person surveys. The survey was transferred to an app version using XLSform and SurveyCTO application (for more information see https://www.surveycto.com/index.html) and uploaded into tablets. This computer-administered survey provides visual materials, excludes inconsistent answers, decreases implementation costs and provides updates on the survey execution (Champ and Welsh, 2006). A face-to-face survey was conducted by eight interviewers who are local residents and undergraduate students in economics and environment economics. Upon completion of a survey, households will receive 40.000 VND (equal to $1.8). Such incentives might have an affect on response rate, response quality, sample composition and response distribution for a in-person survey(Singer and Ye, 2012) The survey was officially approved by the local authorities of city of Hội An.

The baseline should be clearly described in terms of circumstances and the changes related to the current situation, aiming at helping respondents to predict the possible impact of changes to their utility (Johnston et al., 2017). In order to clearly present the baseline, videos introducing current problem of coastal erosion for the entire beach and for each of its segments, comparing it to the coastal situation of those beaches 10 years ago, explaining reasons for coastal erosion, and presenting the impact and expected situation in the next 10 years are attached on the questionnaire.

5.4 Results

5.4.1 Sample description

399 residents participated in the survey. Among them, 39 (9.8% of sample) have been identified as protest answers in the DCE[7], leading to a final sample consisting of 360 respondents. Table 5.3 presents some social-economic characteristics of the sample.

A majority of surveyed respondents are males (68.1%), with high-school attainment or below (71.8%) and with a monthly income lower than $500 per month (62.3%). The

[7]Protest answers are defined as those who have chosen the status quo in all proposed choice sets, and who have stated the following reasons in the follow-up questions: "I don't think that money will be used effectively", "The City of Hội An should pay", "I don't think that the proposed solution is feasible" and "Only rich people should pay" (Meyerhoff and Liebe, 2010; Mariel et al., 2020).

Table 5.3: Socio-economic characteristics of respondents

	Category	Residents
Gender (%)	Female	31.9
	Male	68.1
Age (years)	Mean	52.3
	Min	18
	Max	86
Education (%)	High-school graduate & below	71.8
	Some college/Professional/University	26
	Post-graduate	2.2
Monthly household income (%)	Below $500 (10 million VND)	62.3
	From $500-1000 (10-20 million VND)	27.9
	From $1000-2000 (from 20-50 million VND)	8.8
	From $2000-5000(from 50-100 million VND)	5.6

average respondent's age in above 50 years which is in line with the population age in Hội An.

Table 5.4: Descriptive statistics on distance to beach segments and use of beach segments

		Respondents allocated to segment			
	Full sample	A	B	C	D
No of respondents	360	94	109	72	85
User of Hội An beach (% sample)	89.2	87.2	92.7	88.9	87.1
User of valued segment (% sample)	35.6	20.2	27.5	33.3	64.7
User of segment A (% sample)	20.8	20.2	22	18.1	22.4
User of segment B (% sample)	26.1	25.5	27.5	23.6	27.1
User of segment C (% sample)	40.3	42.6	42.2	33.3	41.2
User of segment D (% sample)	72.2	75.5	72.5	76.4	64.7
Distance to valued segment (in km)					
Mean	5.533	6.442	5.877	5.04	4.503
Min	0.294	0.432	0.294	0.49	0.316
Max	11.012	11.012	9.881	9.104	7.877

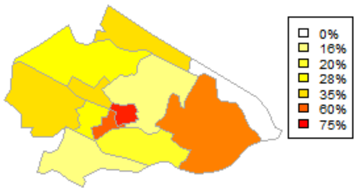
Table 5.4 gives some basic descriptive statistics on respondent distance to beach segments and on respondent use of beach segments. A user of a beach segment is defined as an individual who had visited this segment more than one time last year. It should be noted that the assignment of a respondent to split samples is random by the survey application. Thus, the percentages of four split samples are not exactly equal (26.1%, 30.3%, 20% and 23.6%).

A majority of respondents (89.2%) are users of Hội An beach regardless of the beach segments, whereas only about one-third of full sample are users of the beach segment that they are assigned to value in the DCE section. The percentage of users of each beach segment differs. For example, in the full sample, users of beach A and B, the two most eroded beach, are less than one-third of sample, whereas users of beach C make up 40.3% and users of beach D, a popular and stable beach, make up 72.2%. Moreover, user of the valued segment varies by split-samples. Respondent sample allocated to value segment D have the highest number of users of this valued beach (64.7%), while split-samples of valuing three other beach segments have only 20.2% users (in sample valuing beach A) to 33.3% user (in sample valuing beach C).

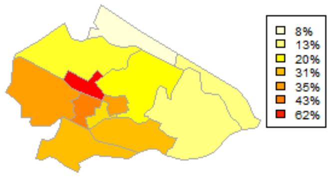
Concerning the distance, the maximum proximity of the full sample to the nearest beach is around 11 kilometers, with a mean of about 5.53 kilometers. This might reflect the fact that Hội An is a small city. In addition, in split-samples of four beach segments, respondents in sample valuing beach A locate the farthest to the valued beach, unlike respondents in sample valuing beach D who stay nearest to the valued beach with a maximum distance of 7.877 kilometers.

5.4.2 Spatial heterogeneity of respondents

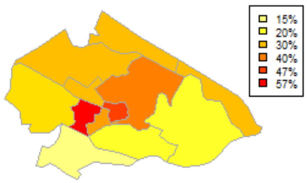
Spatial pattern of several characteristics of respondents are presented in Figure 5.6-5.8.



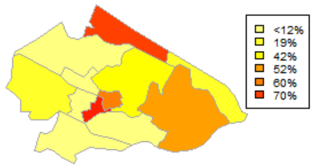
(a) Household with income higher than 10 million VND



(b) Residents educational attainment above high school



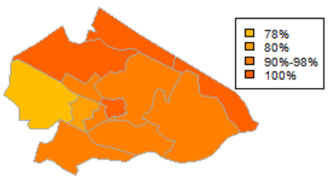
(c) Residents with at least two children



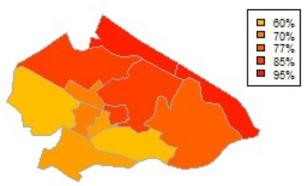
(d) Residents work in tourism related activity

Figure 5.6: Socio-economic characteristics of respondents by commune

More educated residents live in the center and southwest of the city. As expected, the share of residents who work in tourism related activities is higher in northern coastal communes, center communes and inland south-west communes. This reflects the fact that the two main touristic sites of Hội An are the ancient town located in the center of city, and the beaches located in northern coastal areas. The spatial patterns for household income appears to be highly correlated with tourism related activities. Residents who have more children appear to be located in the north and center parts of the city.



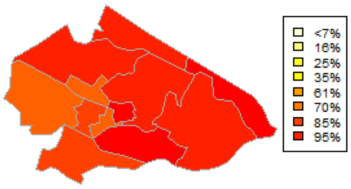
(a) Acknowledge of erosion problem



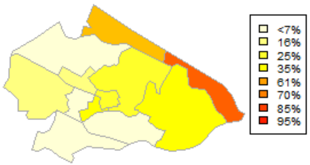
(b) High rank of severity level of coastal erosion

Figure 5.7: Perception of erosion problem by commune

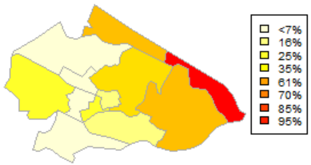
Figure 5.7 presents the percentage of respondents in each commune who think that "Hội An is facing a problem due to coastal erosion" and who state the severity of coastal erosion issues in Hội An at high level. It suggests that most residents acknowledge the problem of coastal erosion (93% of the full sample) and consider this problem a serious situation (76.1% of the full sample). Still, there is a spatial pattern: communes near the beach have a larger number of residents who think erosion issue in Hội An is a serious problem.



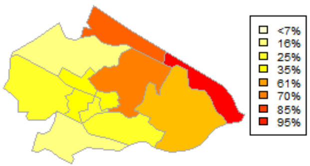
(a) User of Hội An beach



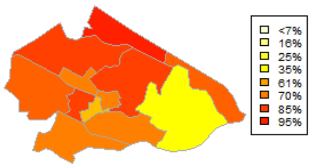
(b) User of beach A



(c) User of beach B



(d) User of beach C



(e) User of beach D

Figure 5.8: Percentage of beach user by commune

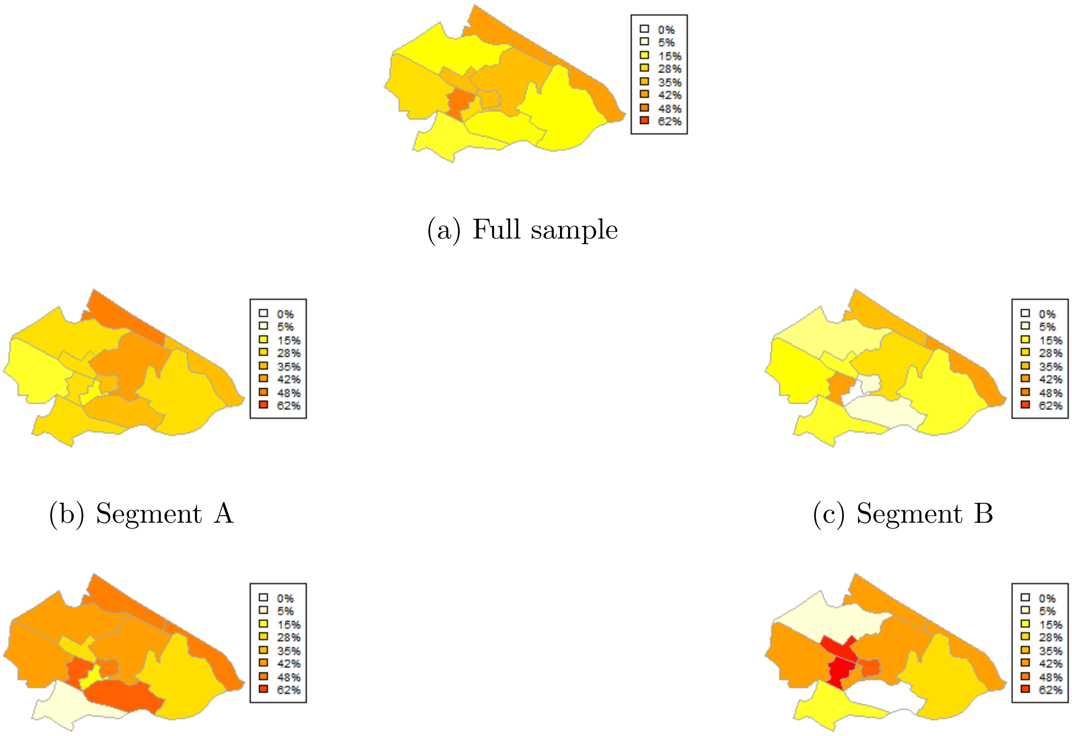
Figure 5.8 show the percentage of beach users in each commune. The share of beach users is higher in communes located near the beach, this spatial patter appears to be true for all beach segments.

5.4.3 Status quo choices in the DCE

In the DCE, respondents have the choice between choosing a program of coastal erosion management (program A or B) or opting for the current situation (status quo). Status quo choices are higher in the sample valuing beach segment C and D (45.14% and 42.94%) than in the samples valuing beach A and B (34.93%, 24.77%), and are 35.79%

in the full sample. It might reflect a difference in choice behaviour across sub-samples valuing different beach segments. The number of status quo choices in our paper is relatively similar to Logar and Brouwer (2018) (27% to 49%) and Holland and Johnston (2017) (33.3%). Moreover, in our sample, there are 16 respondents who have chosen the SQ for in all choice sets, amounting for 4.44% of sample. This groups are dominated by residents who works in others activity than tourism (87.5%).

Figure 5.9 provides a spatial representation of how often respondents opt for to the status quo option in the the DCE.



(a) Full sample

(b) Segment A

(c) Segment B

(d) Segment C

(e) Segment D

Figure 5.9: Percentage of status quo choices in the DCE by commune

Considering first the full sample, center and coastal communes have the highest percentage of status quo choices (more than 42%), whereas communes located in the south-east and in the north have the lowest percentage. However, the spatial pattern is different when considering the four beach segments. For example, respondents with the lowest percentage of status quo selection for beach segment B and D are located in southern and northern communes, whereas they belong to southern east communes for beach segment C, and to eastern communes for beach segment A. The spatial pattern differences for status quo choices in the DCE may stem from differences in respondent characteristics (e.g. income, age or activity related to tourism), differences in beach segment characteristics (e.g. length and width, intensity of beach erosion) or from a combination of both.

5.4.4 Estimation results

We now move to the econometric estimates using data collected in the DCE. Table 5.5 presents estimation results for the three specifications. The MIXL models are estimated with 500 Modified Latin Hypercube Sampling (MLHS) draws (Hess et al., 2006) using *Apollo* package in R (Hess and Palma, 2019).

Table 5.5: MIXL estimation results

Variable	MIXL (1)	MIXL with unidirectional distance (2)	MIXL with multi-directional distance (3)
Mean of random parameters			
ASC	-0.475(0.161)***	0.029(0.353)	0.915(0.548)*
Access	0.007(0.001)***	0.007(0.001)***	0.007(0.001)***
Restaurant	0.186(0.129)	0.18(0.128)	0.191(0.13)
Restaurant-Tree	0.595(0.127)***	0.576(0.127)***	0.609(0.131)***
Tree	0.095(0.119)	0.092(0.118)	0.096(0.119)
Groynes	0.836(0.144)***	0.84(0.144)***	0.822(0.144)***
Concrete revetment	0.527(0.149)***	0.533(0.149)***	0.497(0.151)***
Stair revetment	0.569(0.161)***	0.572(0.161)***	0.532(0.163)***
Sandbags	0.587(0.146)***	0.587(0.145)***	0.532(0.146)***
Width	0.006(0.001)***	0.006(0.001)***	0.006(0.001)***
Standard deviation of random parameters			
ASC	1.64(0.165)***	1.63(0.166)***	1.557(0.166)***
Access	-0.013(0.002)***	-0.013(0.002)***	-0.013(0.002)***
Restaurant	-0.491(0.333)	-0.463(0.344)	-0.503(0.338)
Restaurant-tree	0.873(0.187)***	0.881(0.185)***	0.895(0.187)***
Tree	-0.511(0.232)**	-0.523(0.227)**	-0.504(0.234)**
Groynes	0.58(0.349)*	0.587(0.341)*	0.541(0.369)
Concrete revetment	1.335(0.198)***	1.346(0.198)***	1.376(0.201)***
Stair revetment	-1.107(0.259)***	-1.105(0.261)***	-1.156(0.258)***
Sandbags	1.164(0.211)***	1.148(0.211)***	1.158(0.208)***
Width	-0.006(0.002)***	-0.006(0.002)***	-0.006(0.002)***
Nonrandom parameters			
Tax	-0.184(0.017)***	-0.183(0.017)***	-0.186(0.017)***
Distance to valued beach		-0.732(0.463)	-2.071(0.795)***
Latitudinal distance			-1.197(0.458)***
Longitudinal distance			0.015(0.568)
Sin			-0.485(0.399)
Cos			1.221(0.48)**
Log likelihood	-1995.417	-1994.172	-1987.033
LLR test		(1) vs (2) 2.5	(2) vs (3) 14.28***

Column (1) provides an estimation for the MIXL model without considering any distance effects. It is shown that residents are in favour of a wider and more public beach offering both restaurants and trees. Moreover, they prefer a beach protected by any type of structures over implementing no coastal defence. The negative and significant parameter for ASC expresses their dis-utility for the current situation of the beach.

In the column (2), the unidirectional distance decay effect is tested. However, both the associated parameters and the likelihood ratio test between model presented in columns (1) and (2) are not significant, rejecting the hypothesis that two models are statistically different. It suggest that when we capture only the unidirectional variation of distance, it has no significant influence on utility.

The multi-directional distance function is introduced in the estimation in column (3). The likelihood ratio test between the model with the unidirectional distance function and the multi-directional distance function is significant at 95%, suggesting that the latter has a better fit with the data. Again, the significance of multi-directional distance parameters confirms that spatial patterns of valuation for a coastal erosion management program are complex and that their identification may be difficult by introducing unidirectional distance effects. Specifically, the negative and significant parameter associated with *distance* shows that respondents who live far away from the valued beach decrease their utility for current situation. For the variation of valuation with the angle between residents' location and the valued beach, the significantly positive *cos* parameter suggests that residents located in the south of the valued beach who have $cos(180) = -1$ place lower utility for the status quo option than residents living in the north where cos(0)=1. Furthermore, the latitudinal distance parameter indicates that people who live far away from the valued beach in the north direction are less likely to support keeping the current situation of the beach, which relatively offset the effect of cos parameters. Overall, it reflects that the pattern of distance effect is stronger for those who live in the north than in the south, although residents living in the south of Hội An place higher value for coastal erosion management alternatives than the north.

Moreover, it should be noted from estimations of three specifications that there is relatively no change in the values of random utility parameters of attributes across three estimations. It again suggests that in our model, incorporating the distance effect into the utility function only modifies the preference for implementation of a coastal erosion management programs i.e. moving away from the status quo.

5.4.5 Willingness to pay for implementing a coastal erosion management policy

This section focuses on the willingness to pay for implementing a coastal erosion management policy. It should be first noted that the estimated parameter for ASC captures the specific preference of a respondent for the status quo options in comparison to implementing a coastal erosion management program (Logar and Brouwer, 2018). A positive coefficient indicates a higher utility obtained by a respondent choosing the status quo option. On the contrary, a negative coefficient reflects that opting for one of the two coastal erosion management programs (program A or program B) results in an utility improvement.

A simple way to express change in utility is to compute marginal willingness to pay (WTP). The marginal WTP estimate for coastal erosion management programs from the MIXL model without controlling for distance effect can be written as following:

$$WTP_i = -(-\frac{\beta_1}{\beta_2}) \tag{5.5}$$

where β_1 and β_2 are parameters for ASC and tax in equation 5.1, respectively. Table 5.6 provides the marginal WTP estimates obtained with the MIXL model for implementing a coastal erosion management program, but also for the other attributes included into the DCE.

We first focus on the WTP for the different attributes included in the DCE which appear to be all significant, with the exception of the *restaurant* and the *tree* attribute. The average WTP for one additional percentage of public beach is estimated to be

Table 5.6: Marginal WTP estimates from MIXL model

Attribute	Marginal WTP
ASC	-2.583 (0.771)***
Access	0.037 (0.008)***
Restaurant	1.011 (0.725)
Restaurant-Tree	3.237 (0.788)***
Tree	0.516 (0.661)
Groynes	4.55 (0.91)***
Concrete revetment	2.869 (0.945)***
Stair revetment	3.094 (1.012)***
Sandbags	3.192 (0.883)***
Width	0.033 (0.006)***

Standard error is calculated by the Delta method approach (Daly et al., 2012).

$0.037 per year. As the shoreline of beaches in Hội An is 7600 meters long, this means that each respondent would be ready to pay $0.037 per year to convert 76 meters of private beach into a public one. Although statistically significant, the WTP of residents for a public access to beaches in Hội An is relatively low. For example, residents in South Carolina are willing to pay $2.46 for one additional access point Dixon et al. (2012). Next, we consider the WTP for the various coastal erosion defense measures (*groynes, concrete revetment, stair revetment and sandbags*). We find a significant WTP for protection structures varying from $2.889 per respondents and per year for concrete revetment to $4.55 per respondent and per year for groynes. However, the difference between distribution of WTP for four protection structures is insignificant by the Poe test (Poe et al., 2005). Beach nourishment is also valued by households in Hội An: the annual WTP for one additional meter of beach width is estimated to be $0.033 per respondent. Lastly, we find positive and significant WTP for recreational facilities. The annual WTP per respondent for having a beach with a restaurant or with trees are respectively estimated to be $1.011 and $0.516. Interestingly, we find some complementarities between these two types of recreational facilities, the WTP to pay for a beach equipped with both a restaurant *and* trees being $3.237 per respondent and per year.

Next, we focus on the WTP for implementing a coastal erosion management program. An important insight from Table 5.6 is that households in Hội An express a significant willingness to pay for implementing a coastal erosion management program. The result

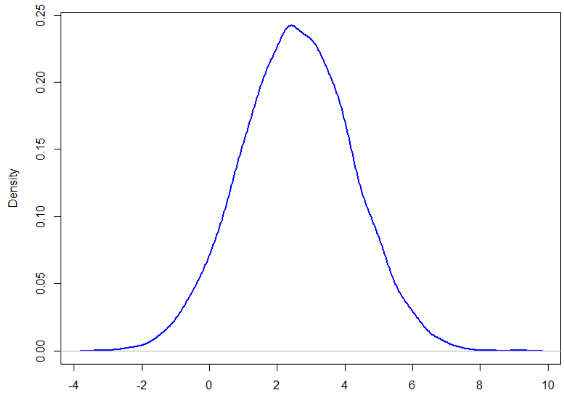


Figure 5.10: Distribution of WTP for implementing the coastal erosion management program under MIXL model

finds that on average Hội An residents are willing to pay \$2.583 per year for moving away from the current situation i.e for implementing a coastal erosion management program. This level of WTP accounts for nearly 0.05% of household income of the majority of the sample. Compared to previous studies, it is relatively lower than in, for example, Johnston et al. (2018) which find the annual WTP of \$175.82 per person for a nonstatus quo protection plan in Connecticut, the US. Some heterogeneity among respondents is documented. The distribution of WTP on implementing the coastal erosion management program is provided in Figure 5.10. 94.2% of our respondents are willing to pay a positive amount of money for implementing a coastal erosion management program. A majority of the residents would have WTP lower or equal to the distribution median at \$2.563. Moreover, the 95% and 99% percentile of the distribution are \$5.27 and \$6.324 above which almost no residents would want to pay more.

Finally, we consider the marginal WTP estimates for implementation of coastal erosion management program obtained using the MIXL model with multi-directional distance. Using the distance decay function (5.3), we have:

$$WTP_i = -(-\frac{\beta_1 + f_i(x,y)}{\beta_2}) \tag{5.6}$$

Since the WTP depends in that case on the location (x, y), it varies over space

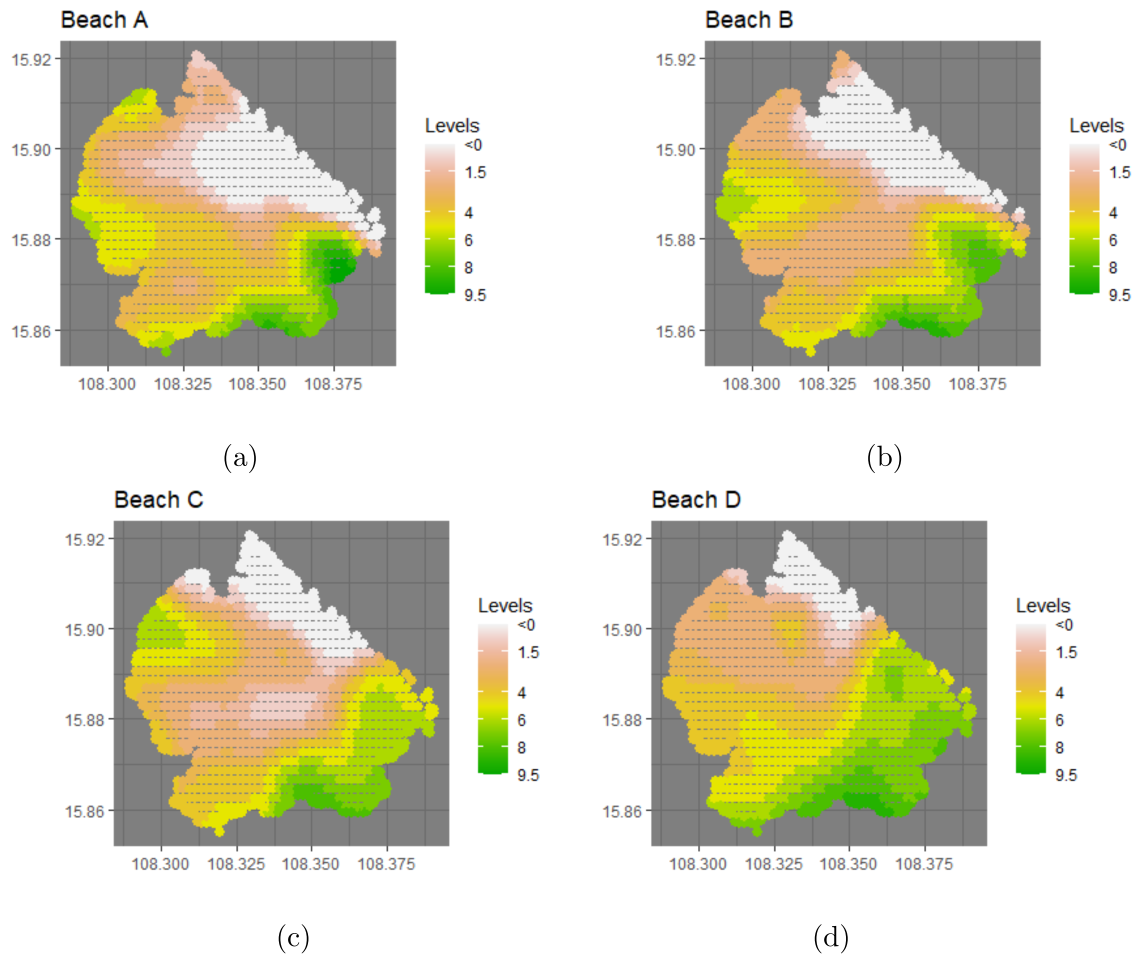


Figure 5.11: WTP for implementing a coastal erosion management program by beach segment
(MIXL model with multi-directional distance function)

(see Figure 5.11). The smoothed representation of the WTP has been obtained by using kriging techniques with a GAM interpolation [8]. It can be observed from the map that the WTP for implementing a coastal erosion management program varies depending the direction in space space, which confirms the importance of accounting for multi-directions in distance effect. There are several observations that can be implied from the map.

First, residents in the southeast of the city generally have the highest WTP for implementing a coastal erosion management program. This may be explained by the fact that households living in these areas have high levels of income and education. Another explanation is that this area is located along the Thu Bon river and at the

[8] It is a non-parametric smoothed function of WTP on respondents' geolocation (Olsen et al., 2020)

river mouth. This region is known to be more vulnerable to climate change and to natural disasters such as flooding, river erosion and saline intrusion (UN-Habitat, 2014). Being more vulnerable to climate change and natural disasters may results in higher WTP for being protected (Brouwer et al., 2009).

Second, compared to beach segment A, B and C, there is a substantially higher WTP to implement a coastal erosion management program for beach segment D (compared to the three other beach segments, the green/yellow area is larger and the withe area is lower). More specifically, the mean WTP to implement a coastal erosion management program is $3.59 per respondent and per year for beach segment D and it is positive for 93% of the respondents. Whereas, the mean WTP for that in beach A, B, C are $2.253, $2.448, $2.641 with 82.3%, 83% and 87.8% residents having positive WTP, respectively. It might reflect a fact that for a popular beach segment which is stable in term of erosion but is currently not protected by any erosion protection program, a majority of the city are willing to pay for implementation of coastal erosion management programs. On the other hand, for beach segments that have faced with serious erosion but have been currently implementing some protection measures, the WTP for implementation of an additional coastal erosion management program is lower. Lastly, among coastline areas, residents living around a specific beach segment have a lower WTP for the implementation of coastal erosion management programs in this beach segment than that in the adjacent segments. For example, residents living in beach segment A and B place a negative WTP for the implementation of coastal erosion management programs in these two segments but have a positive WTP for that in beach C and D (see Figure 5.11). That might reflect a sign of spatial interactions to coastal erosion protection across coastal population in four beach segments (Gopalakrishnan et al., 2017, see Discussion section).

5.4.6 Individual heterogeneity and distance effects

Literature finds a variation of distance effect according to respondents' scio-economic characteristics (Glenk et al., 2020). In this section we introduce individual heterogeneity in the distance-decay function based on observed characteristics of residents. Let D denotes a household characteristic supposed to have an impact on the distance decay function. The multi-directional distance-decay function for respondent i now becomes:

$$
\begin{aligned}
f_i(x,y) \quad = \quad & \beta_j Distance_i + (\phi_1 Longitude_i + \phi_2 Latitude_i) + (\varphi_1 \cos\theta_i + \varphi_2 \sin\theta_i) + \\
& \gamma_j Distance_i * D_i + (\delta_1 Longitude_i * D_i + \delta_2 Latitude_i * D_i) + \\
& (\lambda_1 \cos\theta_i * D_i + \lambda_2 \sin\theta_i * D_i) \qquad (5.7)
\end{aligned}
$$

We have tested several characteristics of residents including socio-economic factors (level of education, income, age, gender, economic activities, having more children, having elderly people in the family), perception on the coastal erosion issue in Hội An (acknowledge of coastal erosion, rank of the severity level of coastal erosion, impact by coastal erosion), beach usage, personal economic preference (risk taking, time discounting, altruism, trust, environment). Table 5.7 presents our estimation results where D are beach user, having more children and high-income residents since beach usage is of our interest and parameters for these two latter variables are significant (see Appendix D for description of these variables).

Column (1) presents the estimation of the model with a multi-directional distance decay effect and where D is a dummy variable equal to one if the respondent is an user of the valued beach. At the exception of the coefficient for Sin, none of the interaction parameters between the dummy variable for beach user and the distance appears to be significant. Moreover, using a likelihood test, we reject the null hypothesis that there is a significant difference between this model and the MIXL model with a multi-directional distance decay function (without controlling for the effect of the dummy variable for beach users). We conclude that the spatial pattern for utility derived from implementing a coastal erosion management program is not different for users and non-users of the Hội An beach.

In column (2), D corresponds to a dummy variable equal to one for high-income respondents. Estimation results show that spatial pattern of preference of lower-income

Table 5.7: MIXL estimations with multi-directional distance effect and observed individual heterogeneity

Variable	MIXL with D =User (1)	MIXL with D =high-income (2)	MIXL with D =Children (3)
Mean of random parameters			
ASC	0.681(0.589)	1.035(0.536)*	0.832(0.542)
Access	0.007(0.001)***	0.007(0.001)***	0.007(0.001)***
Restaurant	0.197(0.13)	0.184(0.129)	0.191(0.13)
Restaurant-Tree	0.618(0.132)***	0.595(0.131)***	0.606(0.131)***
Tree	0.106(0.119)	0.096(0.118)	0.101(0.119)
Groynes	0.825(0.144)***	0.819(0.143)***	0.818(0.144)***
Concrete revetment	0.497(0.152)***	0.505(0.151)***	0.492(0.151)***
Stair revetment	0.534(0.163)***	0.529(0.162)***	0.526(0.163)***
Sandbags	0.541(0.146)***	0.529(0.145)***	0.531(0.147)***
Width	0.006(0.001)***	0.006(0.001)***	0.006(0.001)***
Standard deviation of random parameters			
ASC	1.534(0.165)***	1.522(0.163)***	1.533(0.168)***
Access	-0.013(0.002)***	-0.012(0.002)***	-0.013(0.002)***
Restaurant	-0.53(0.315)*	-0.487(0.337)	-0.523(0.338)
Restaurant-tree	0.918(0.187)***	0.921(0.183)***	0.887(0.19)***
Tree	-0.486(0.254)*	-0.479(0.243)**	-0.507(0.235)**
Groynes	0.563(0.342)	0.555(0.355)	0.568(0.346)
Concrete revetment	1.389(0.202)***	1.378(0.196)***	1.361(0.201)***
Stair revetment	-1.16(0.257)***	-1.128(0.257)***	-1.162(0.253)***
Sandbags	1.151(0.211)***	1.158(0.205)***	1.169(0.205)***
Width	-0.006(0.002)***	-0.006(0.002)***	-0.006(0.002)***
Nonrandom parameters			
Tax	-0.187(0.017)***	-0.186(0.017)***	-0.186(0.017)***
Distance to valued beach	-2.233(1.062)**	-2.169(0.806)***	-2.819(0.821)***
Latitudinal distance	-1.279(0.498)**	-1.088(0.503)**	-1.018(0.541)*
Longitudinal distance	0.53(0.742)	-0.616(0.58)	-0.188(0.575)
Sin	-1.381(0.635)**	-0.076(0.413)	-0.788(0.448)*
Cos	1.462(0.647)**	1.203(0.499)**	0.679(0.524)
Distance to valued beach * D	0.508(1.239)	-1.852(1.699)	3.208(1.314)**
Latitudinal distance * D	0.21(0.949)	0.32(1.025)	-0.817(0.933)
Longitudinal distance * D	-0.765(0.997)	2.899(1.429)**	1.848(1.277)
Sin * D	1.368(0.74)*	-2.982(1.053)***	0.523(0.77)
Cos * D	-0.75(0.758)	-1.226(1.102)	1.889(0.839)**
Log likelihood	-1983.957	-1980.79	-1981.917
LLR test[a]	6.14	12.48**	10.22*

Note: [a] LLR test with MIXL model with multi-directional distance decay function in column (3) of Table 5.5

residents ($D = 0$) for implementing management program is relatively similar to that of the full sample. That is to say, for low-income residents, those living faraway from the valued beach to the southeast direction increase their WTP for implementing coastal erosion management program. For the high-income residents, the negative parameter for the interaction between $high - income$ and sin indicates that high-income residents living in the east (i.e. where sin(90)=1) get a lower utility for keeping the current situation than those in the west (i.e. where sin(270)=-1). However, this effect is neutralized by positive longitudinal distance effect among high-income residents which suggests that the reverse distance-decay effect is stronger for high-income residents who reside in the west than in the east. Generally, residents living in the southeast of the valued beach value the implementation of coastal erosion management programs more than people living in the northwest, however, the effect is leveled out to the increasing distance, especially for the high-income residents. Figures F.5-F.8 provides a clearer understanding of how variation in income impacts on distance decay. Accordingly, the patterns are slightly different for high-income residents compared to low-income. The reverse distance decay effect is stronger for high-income than low-income residents. Moreover, for areas that are located nearer to beach, low-income resident is more willing to pay for the implementation of management programs for coastal erosion than the high-income residents, on the other hand, the further the distance is, the higher WTP of the high-income resident compared to the low-income resident.

Since enjoying the beach is a family activity, the last observed characteristic we have introduced in column (3) is a dummy variable equal to 1 for households having more than one child. While there is a distance decay effect on preference of residents having more children for the implementation of the coastal erosion management program, a reverse effect is found with residents who have less children. Moreover, the significant directional parameters indicates that among residents who have children, people living in the southeast attach with higher utility for implementing management programs than those residing in the northwest. These patterns can be seen from the visualization in figure F.9-F.12. Firstly, for residents having more children, the closer they live to the southeast direction to beach, the higher WTP they place for implementation of coastal erosion management programs. This distance decay effect could be explained by the substitute recreational activities: the presence of several traditional villages which offers other forms of recreation for children in families that live far from the beach. Secondly, WTP for the implementation of coastal erosion management programs of residents who have more children is higher than that of residents who have less children if the proximity to the beach is sufficiently low. Thirdly, among the four beach segment, beach C and D have the highest difference of WTP between residents who have more children and who have less children. A possible reason might be that residents who have more children have a higher visitation of these beach segments than those who have less children. Indeed, in the group of residents having more children, 50.6% and 79.8% are users of beach C and D, compared to 35.7% and 68.5% of residents having less children. Meanwhile, users of beach segment A and B are relatively similar between two groups, at 21.8% and 28.6% of having-more-children residents compared to 20.3% and 24.9% of having-less-children residents.

5.5 Discussion

We summarize in this section the main results of our empirical analysis, and we derive some policy implications for coastal erosion management in Hội An.

Residents express some preferences for implementing coastal erosion management programs i.e. for moving away from the status quo. This is opposite to common evidence on status quo bias which suggests that people tend to incline to the current state of goods due to the cognitive cost .i.e. the increased task complexity on analysing other alternatives (Boxall et al., 2009), the protest attitude (Meyerhoff and Liebe, 2009) and the familiarity and deeper understanding of the current situation (Scarpa et al., 2007). However, our finding is aligned with several studies on economic valuation of coastal erosion management which have reported a negative preference for the status quo (see, for example, Johnston et al., 2018; Huang et al., 2007; Borger et al., 2021). A possible explanation could be the fact that coastal erosion is acknowledged by most residents in Hội An (93%) as a serious problem. This might lead them to be more favorable to the implementation of a management program to combat this issue.

Resident's preferences for coastal erosion management programs follow spatial patterns. In particular, the further away they are located from the beach, the higher their WTP for implementing a coastal erosion management program is. We find that people living far away from the valued beach tend to have a higher utility and a higher WTP for implementing a coastal erosion management program, a result which may appear in contradiction with what could have been expected and with the existing literature (e.g. Hanley et al., 2003; Bateman et al., 2006; Logar and Brouwer, 2018; Schaafsma and Brouwer, 2020). We propose here several explanations for this result.[9] Firstly, since the beach in Hội An is considered an iconic asset, it's valuation may not be affected by distance in the usual way (Rolfe and Windle, 2012). Second, Hội An beach is the only beach in the city and there is no substitute. If people cannot access the beach in Hội An, they will have to drive long distances to other beaches, especially those located far away from the beach (Artell et al., 2019; Nielsen et al., 2016). Third, people located near the beach may have already experienced coastal erosion. Having experienced the phenomenon, they may find the current situation more acceptable and they may be less inclined to implement coastal erosion management programs compared to respondents located far away. This is in line with (Warren et al., 2005) who show that local people may become more favourable towards windfarms after they have been constructed.

Spatial patterns of preferences for coastal erosion management programs are better represented using a multi-directional distance decay function compared to a unidirectional one. The visualisation of spatial patterns of WTP for the implementation of coastal erosion management programs in each of four beach segments points out that residents in the southeast of the city where the river goes through and the river-mouth is located have the highest WTP for moving away from the current situation of the valued beach. This is in line with previous studies which suggest the usage of a more complex form of

[9] Respondent self-selection may be an explanation but not in our case since respondents have been randomly sampled.

distance, for example, in ecological quality improvement of lake (Schaafsma et al., 2012), river restoration (Logar and Brouwer, 2018) and riparian land restoration (Holland and Johnston, 2017).

The spatial patterns of respondent's preferences for coastal erosion management programs vary according the beach segment considered. Moreover, residents living in the coastal segment tend to have higher WTP for management programs in adjacent segments than the segment they live in, the trend is clearer for those who are located in the southern coastline. Among the four beach segments, the average highest WTP is for beach D which is a stable sandy beach, located in the north and not protected by any measure. It should be noted that the southern coast is located near the river mouth, and sediments process often moves from the north to the river mouth in the south (Viet et al., 2015). It means that the southern coast can gain spillover benefit from the nourishment in the northern coast. It might be the explanation for the higher WTP for implementation of coastal erosion management programs in northern beach segment compared to the southern ones (Williams et al., 2013). Moreover, this finding might reflect an acknowledgement by Hội An residents that the benefit generated from a coastal erosion management is not fully held by a single community, but that the benefit is shared by neighbours (Gopalakrishnan et al., 2017, 2018).

Some observed characteristics of respondents contribute to the heterogeneity of spatial preferences towards coastal erosion management programs. The variation of the distance effect is analysed by exploring the influence of income, having children and frequency of visiting beach last year. We find no significant difference in distance effect between users and non-users, which is similar to Lizin et al. (2016). It might indicate a fact that weak complementarity does not hold in our case. In other words, there is likely a dominance of "existence value" in the economic values from a coastal erosion protection program in Hội An, as suggested by Landry et al. (2020) and Ardeshiri et al. (2019). Respondents still have benefit from knowing the existence of a beach erosion management program and the protection of beach even if they have not visited and had recreation activity on the beach (Loomis and White, 1996). However, for residents who have more children, estimation results point out a distance decay effect on their preference for a coastal erosion management program. Moreover, this effect is more rapid for the valuation of the two popular beach segments (beach C and D) than the eroded segments (beach A and B). It reflects a component of recreational values that a beach erosion management brings for families with more than a child. Moreover, we find a stronger reverse distance decay effect for high-income residents than those of low-income residents.

Our findings have direct implications for coastal erosion management in Hội An.

Firstly, residents can contribute to funding the coastal erosion management program. Annual household tax could be a feasible instrument, which has been considered in other studies (Johnston et al., 2018; Matthews et al., 2017a).

Secondly, the variation of spatial patterns across the four beach segments suggests that tax schemes may be differentiated by beach segments. For example, compared with other segments, the highest WTP for implementing management programs of coastal erosion in segment D promotes a higher tax devoted for this stable and popular beach segment than those which have applied several protection structures.

Thirdly, evidence on spatial patterns and its heterogeneity supports a policy of charging different tax rate to different groups of household. The tax could be based on household income or on the value of housing. Using an agent-based model, Mullin et al. (2019) show that a delineation of tax rates for coastline management projects allows to account for the difference in levels of support and the unequal benefits gained by local population. Implementing that could encourage the funding of the project.

5.6 Conclusion

There is now compelling evidence that preferences for environmental goods follow particular spatial patterns. In this work, we have developed a DCE to explicitly address the spatial dimension of taste heterogeneity across residents for coastal erosion management programs in Hội An (Vietnam). It confirms the importance to capture the multi-directional spatial heterogeneity in valuation rather than controlling only the uni-directional spatial preference. The spatial pattern of preference for coastal erosion management programs differs across beach segments.

A few extensions could be proposed. Firstly, since our sample is limited by the boundary of the city, further research can be employed in a larger scale to assess the valuation of management of coastal erosion in Hội An from other adjacent cities. Second, in this paper, our interest is the variation of WTP for implementation of a coastal erosion management program or for moving away from status quo across space. However, preference on other attributes might follow a different spatial pattern. In a hedonic price study, Gopalakrishnan et al. (2011) suggests that coastal property values have been influenced by beach width with the condition that the proximity of property to the coastline is relatively low. An additional study could then further explore the spatial pattern of residents' valuation on beach width.

Finally, from a policy perspective, our results may help to design appropriate incentives encouraging the funding of coastal erosion management programs. Accounting for spatial differences in preferences may be useful to aligning the proposed programs with public interest.

Chapter 6

Conclusion

6.1 Summary of findings

We have contributed to the existing literature by assessing the valuation of both tourists and residents for a coastal erosion management in Hội An, a tourism hotspot that is facing serious coastal erosion. The thesis remarks six main findings.

First, the results confirm that both tourists and residents are willing to pay for coastal erosion management program of the beach. Tourists' WTP is higher than that of residents, at about $12.89 and $2.64 for the implementation of coastal erosion management programs i.e. moving away from status quo, respectively.

Second, the results point out a preference of both groups for a wider and more public beach that is protected by structures.

Third, results suggest several differences among the two groups of respondents in terms of protection structures and recreational facilities. Tourists are inclined to the construction of hard protection structures irrespective of the type of structures, while residents place the most value on groynes which allow the accessibility of the sea. Residents are only willing to support a facilitated beach with trees and restaurants, whereas tourists favor a more pristine beach with only trees.

Fourth, acknowledgement and experience of the coastal erosion problem plays a role on residents' choice behaviour for a coastal erosion management program. Residents who have stated to be highly impacted by coastal erosion and who have acknowledged coastal erosion problem in Hội An place higher values for coastal defence structures than others. In addition, respondents' choice randomness, especially in the group of residents, is likely driven by prior acknowledgement of coastal erosion and task complexity. These factors might lead them to make the choice task in DCE based on their prior experience rather than interpreting the choice card by well-defining preferences.

Fifth, the results show an evidence of multi-directional spatial heterogeneity in the valuation of coastal erosion management. Specifically, residents living far away from the valued beach, especially in the southeast direction have higher utility for the implementation of coastal erosion management programs. Although in contradiction with existing literature on the distance decay effect, this result reflects a recognition of Hội An beach as an iconic asset by local residents across the city. Moreover, while income and having children contribute to the heterogeneity of spatial preferences towards coastal erosion management programs, previous usage of the beach plays no effect on spatial preference heterogeneity. This might indicate a dominance of "existent value" in the economic values from a coastal erosion management program in Hội An. Still, this program brings a significant component of recreational value for group of residents who have more than one child.

Finally, it is relevant to account for the particularities of beach segments which differs in terms of erosion rate and characteristics. In other words, respondents' preferences and valuations vary across the four considered beach segments. For example, respondents have a higher WTP for protection structures in the most eroded segment and the most popular segment. A highest percentage of respondents is willing to pay for the implementation of coastal erosion management programs in the most popular and stable segment that has not been protected by any protective measure. Moreover, the spatial patterns of respondents' preferences for coastal erosion management programs vary according the beach segment considered.

6.2 Policy implications

The findings of the thesis support several implications for the coastal management authorities in Hội An.

First, a beach management program should ensure the improvement of the beach area and beach access. Coastal tree plantation is encouraged to be implemented to promote green space at every beach segment.

Second, an efficient coastal management policy strategy that both conserves the coastline and promotes tourism is a combination of beach nourishment with the construction of a structural defence. Among several protective structures, groynes are viable erosion management strategies that are supported by the majority of Hội An's tourists and residents.

Third, estimation results suggest the need to account for specific characteristics in different beach segments from a policy perspective. It should be noted that the state of erosion in a segment always affects the erosion process in its neighbour beaches. Therefore, each beach segment should be applied a specific management program, but authorities should take into account the impact of these programs on the others. In other words, an intra-site management for each beach segment should be developed under a coordinated coastal management for the whole beach. Moreover, instead of implementing coastal erosion protection programs on only currently eroded beaches, the authority should also carry out a coastal erosion policy in the beach segment which has been stable to erosion.

Finally, the thesis implies several recommendations in terms of a financial plan for a coastal erosion management program in Hội An. Firstly, the thesis suggests the relevance to raise some money from tourists to fund the construction of protection structures for preventing coastal erosion. About 5.35 million tourists having visited Hội An in 2019 who could have a total potential annual contribution of approximately $37.6 million for protective measures. The amount of money collected from tourist tax is expected to sufficiently fill the budget gap on coastal erosion mitigation. Secondly, findings on the spatial dimension of valuation and the dominance of existence values for a coastal erosion management program in Hội An indicate the feasibility of a locally administered fundraising instead of a similar tax scheme for the whole population.

6.3 Future research

Cost benefit analysis The thesis has provided an analysis of economic valuation by both tourists and residents on different attributes of a coastal erosion management program in Hội An. In order to support decision making of authorities, cost-benefit analysis could be implemented on different coastal erosion management scenarios. However, traditional cost-benefit analysis has been criticized due to the ignorance of uncertainty in climate changes (Ekholm, 2018) and the long-term environmental and social impacts (André et al., 2016). Therefore, a multidimensional picture of coastal erosion impacts such as loss of tourism revenue, property and spillover effect on adjacent beaches should be considered in a cost-benefit analysis of a coastal erosion management program. Moreover, the frequency of storms and sea level rise which have contributed to the coastal erosion process could be added to capture the climate change impact on a management program. They might play as an exogenous variable in the function of the cost of a coastal erosion management program. Additional data on annual tourism revenue, storm frequency and different sea level rise may required to conduct the cost-benefit analysis.

Spatial feedback on coastal erosion management in adjacent cities The results in chapter 5 find an evidence of a reverse distance decay effect, reflecting the recognition as an iconic asset of Hội An beach that receives valuation of the whole population across Hội An city. One possible explanation is that there is no substitute beach for Hội An residents or that the substitution is located very far from the city. However, the result on the distance effect might be different if we consider the respondent sample at larger scale where residents have different substitute beaches, for example, My Khe beach (Da Nang city). The substitution effect implies that respondents who live near an alternative beach decrease their welfare for the management program of the valued beach (Schaafsma et al., 2013).

In addition, using an hedonic pricing approach, Gopalakrishnan et al. (2017) point out a spatial interaction between neighbouring communities on coastal erosion management. For instance, a town will provide less beach nourishment thanks to spillover benefit from their adjacent area which has implemented a beach nourishment program.

In fact, Hội An beach and its adjacent beach, My Khe are considered two of the most beautiful beaches in Vietnam, and have recently both faced increasing coastal erosion. The coastal erosion processes in the two cities interact with each other. Under the need of a coordinated management on the broader scale, in 2017, authorities in these two provinces launched a coordination board for general management of coastal area in the two cities. However, due to substitution effects and spatial interaction of two cities, residents might have different benefits of the coordinated coastal erosion management. Therefore, additional research could be conducted to assess how local people in two provinces (Hội An and Da Nang) value a coastal erosion management program both in single cities and under a coordinated program of two cities. It might allow to analyse how residents feed back with coastal erosion management in their neighborhood and the substitution effects on the residents' valuation.

Hedonic prices model on impact of coastal erosion on land price Another economic valuation approach to investigate the impact of coastal erosion is to assess impact of coastal erosion on land price using hedonic pricing approach. Previous hedonic price studies found evidences that beach width and beach quality influence coastal property values (Gopalakrishnan et al., 2011; Catma, 2020), the rate of coastal erosion (Landry and Allen, 2019; Filippova et al., 2020) with the condition that the proximity of property to the coastline is relatively low. With the availability of data on Hội An land prices and eroded coastal area over years, future research could examine how land values in Hội An are affected by the proximity to the Old Quarter or to the shoreline, the beach quality, and the erosion rate, and to establish what distance to the shoreline erosion influences land prices. Moreover, a spatial hedonic price approach could be applied in order to capture the spatial dependency between land values.

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Appendices

Appendix A

Full questionnaire

Name of Interviewer: Interview date:
Address of Interview: Coordinates GPS:

Hello, my name is ... I'm from Hochiminh University of Economics and Law.

We are working on a research project on coastal erosion in Hội An, which is the fact that beaches gradually narrow and may disappear (causing a landward retreat of the coastline). We conduct this survey to better understand opinion of visitors to Hội An and the residents here on the problem of coastal erosion.
Do you have some time for answering our questionnaire? It will only take about 30 minutes, and to thank you for your time, we will give you a small gift at the end of the survey.
Your answers will be used for research purposes only, and we will keep them confidential and anonymous. Your responses are very important and valuable for us since they may contribute to make further improvement to the coastal erosion policy here.

Do you consent to participate in this survey?
☐ Yes ☐ No

A.1 PART I OF TOURISTS: Information about the trip

First I would like to ask you a few question about you and your trip in Hội An
1. In which country do you usually live?

2. Total duration of your trip in Vietnam? (...days)
3. How long do you stay in Hội An? (...days)
4. Do you plan to visit Hội An beach?
☐ Yes ☐ No ☐ Don't know
5. If not, why did you not plan to go to beach in Hội An?

I didn't know there is beach in Hội An	
I don't have time enough	
There are more interesting things to do in Hội An	
There are more beautiful beaches elsewhere in Vietnam	
Other reason (Please specify)	

6. Which is the main purpose of visiting the beach in Hội An?

Swimming	
Relaxing and Sunbathing	
Enjoying landscape	
Enjoying seafood, restaurant, bars	
Other reason (Please specify)	

7. Now, I will ask you a question about your preferences for general beaches.
On average how many times do you go to a beach per year?
8. Do you think that Hội An is facing a problem due to coastal erosion, which is the removal of sand from the coast by wave action and/or the activities of man, typically causing a landward retreat of the coastline?
☐ Yes ☐ No ☐ Don't know

A.2 PART I OF RESIDENTS: Attitudes towards coastal erosion in Hội An and the use of beaches

First I would like to ask you a few questions about your opinion regarding some environmental issues in Hội An
1. Please rank the severity level of some environmental issues in Hội An
Please use scale from 1 to 5, which 1 = not severe at all, 5 = highly severe

	1	2	3	4	5
Air Pollution					
Water pollution					
Liter					
Loss of biodiversity*					
Temperature warming					
Coastal Erosion					
Flood					

*Loss of biodiversity: is the extinction of species (human, plant or animal) worldwide, and also the local reduction or loss of species in a certain habitat.

2. Do you think that Hội An is facing a problem due to coastal erosion, which is the removal of sand from the coast by wave action and/or the activities of man, typically causing a landward retreat of the coastline?
☐ Yes ☐ No ☐ Don't know
3. (If Yes) How do you discover about this problem of Hội An (i.e coastal erosion)

Real experience (I've seen it myself)	
I hear from my family/friends/neighbour	
I saw from media (TV, internet, social media, newspaper,...)	
I receive the infomation statement from local government	
Other reason (Please specify)	

4. For you, what are the main reasons for having coastal erosion in Hội An?

Sea level rise	
Increasing frequency of storms	
Sand mining in the Thu Bon river	
Dam construction in the Thu Bon river	
Natural variation (shoreline naturally moves)	
Hotels built in inappropriate places	
I don't know	

5. How is the impact of coastal erosion on your own life?
Please use scale from 1 to 5, which 1 = No impact at all, 5 = high impact

	1	2	3	4	5
Property loss (houses, lands, etc.)					
Loss of economic activities (jobs, working opportunities, etc.)					
Loss of recreational activities (swimming, sunbathing, etc.)					

6. In the last year, how often do you go to a beach in Hội An?

Everyday	
Twice a week	
Once a week	
Once a month	
4 times per year	
2 times per year	
Once a year	
Never	

7. In general, how long do you stay on the beach in Hội An?

A few hours (or less)	
Half a day	
A full day trip (from morning to late afternoon)	

8. In general, who do you go to the Hội An beach with?

Alone	
With family	
With friends	
With other people	

9. Reasons for going to the Hội An beaches?

Swimming	
Relaxing/Enjoying landscape/Sunbathing	
Enjoying seafood, restaurant, bars	
Working (I have business on the beach or I work on restaurant/hotel/resort near beach)	
Other (Please specify	

10. How often do you go to other beaches not in Hội An (Da Nang for instance)?

Everyday	
Twice a week	
Once a week	
Once a month	
4 times per year	
2 times per year	
4 times per year	
Once a year	
Less than once a year	
Never	

11. How many times in the last year have you been on the different parts of the Hội An beach?

Beach A (Vinpearl resort to northern point of Sunrise resort)
Beach B (Northern point of Sunrise resort to southern point Golden Sand resort)
Beach C (Southern point Golden Sand resort to the end of Palm Garden resort)
Beach D (An Bang beach)

	Beach A	Beach B	Beach C	Beach D
Everyday				
Twice a week				
Once a week				
Once a month				
4 times per year				
2 times per year				
Once a year				
Less than once a year				
Never				

A.3 PART II: CHOICE EXPERIMENT

A.3.1 Background Information

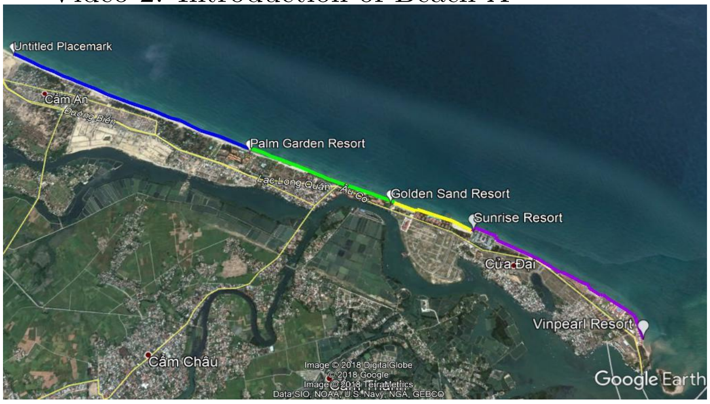
We would now like to know what you think about possible coastal erosion management programs which could be put in place to protect Hội An beaches from coastal erosion. Let me first start by giving you some general information about erosion in Hội An.

Video 1: Introduction of erosion in Hội An

Now, I would like to get your opinion about some coastal erosion programs which could be implemented on a specific part of the Hội An Beach.

All the questions I am going to ask are related only to Beach A which is about 2km (1.2miles) of beach from southern start of Vinpearl resort to northern end of Sunrise resort.

Video 2: Introduction of Beach A



A.3.2 Choice Experiment

According to international and local scientists and authorities in Hội An, there are some technical solutions that can reduce the erosion in this part of beach. In this section, we will try to better understand your preferences for different types of programs that can be used. Each program is described by 5 dimensions that I am going now to describe to you. Let me know explain to you what the exact meaning of each program's dimension is.

Video 3: Introduction of characteristics of a coastal protection program

Do you have any questions about the film? Do you want to see it again?

I am going to ask you to make a choice between 3 options:

Current situation: most likely situation in the above beach for the next 10 years without implementing any additional program. You don't have to pay any additional tax in the current situation.

Program A: a possible coastal erosion management program that could be implemented. You have to pay a tax to cover the cost of program A.

Program B: a possible coastal erosion management program that could be implemented. You have to pay a tax to cover the cost of program B.

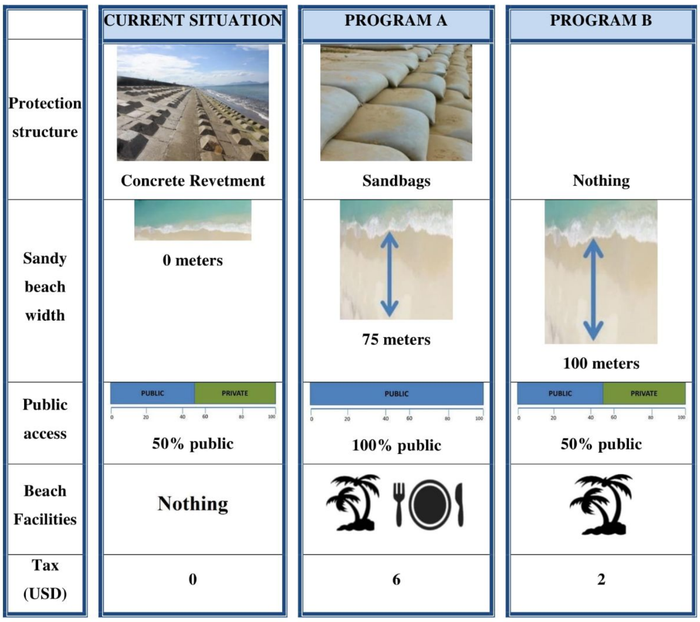
I am simply going to ask you if you prefer the current situation, program A or program B. You will repeat this task 6 times with different programs A and B.

When you make your choice:

- Carefully consider the implications of each coastal erosion management program by looking at the dimensions' values listed in the associated table.

- Remember that each program can have both positive and negative outcomes for you.
- Please complete ALL choice sets.
- Take all the time you need for answering.
- What is really important for me is to get your own opinion. There is no good or bad answer, what matter is what YOU prefer.

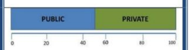
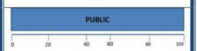
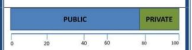
Let's start with an example



Please choose your preferred program

Current situation	Proposed program A	Proposed program B

Now we begin the real experiment
Experiment start time

	CURRENT SITUATION	PROGRAM A	PROGRAM B
Protection structure	 Concrete Revetment	Nothing	 Groynes
Sandy beach width	 0 meters	 50 meters	 150 meters
Public access	 50% public	 100% public	 75% public
Beach Facilities	Nothing		Nothing
Tax (USD)	0	4	6

Please choose your preferred program

Current situation	Proposed program A	Proposed program B

In the choice selection, how sure you are about your answer?

Please use the scale which 1 = Extremely hesitant; 5 = Completely sure

1	2	3	4	5

Experiment end time

A.3.3 Follow-up questions

12. Do you think that it is fair to ask tourists to pay for erosion protection?

☐ Yes ☐ No

13. What are the main reasons that you have chosen - CURRENT SITUATION - in at least one choice selection?

I prefer the current situation in these choice sets	
I prefer the current situation than pay more	
I do not think that the protection of the Beach is worth doing	
I cannot afford to pay	
I don't think that money will be used effectively	
The City of Hội An should pay	
I don't think that the proposed solution is feasible	
Only the rich persons should pay	
I am not interested in the problem	
Other reasons (Please specify)	

A.4 PART III: DEMOGRAPHIC INFORMATION

14. Your age
15. Gender
16. Your education

None	
Conmplete Primary school	
Complete Secondary school	
Complete High school	
Vocational Training	
Professional Secondary school	
College	
University	
Post-graduate	
I don't want to answer	

17. Number of people in your household
18. Number of children below 18 in your household
19. Number of people above 65 years old in your household
20. *(For only residents)* What is the main type of your household's economic activity?

Travel Agency/Company: Owner or Employee	
Restaurants: Owner or Employee	
Hotels/resorts: Owner or Employee	
Other tourist related activities	
Other activities	

21. Your household's total income per month

For resident

0 to 500 USD	
500 to 1000 USD	
1000 to 1500 USD	
1500 to 2000 USD	
2000 to 3000 USD	
3000 to 5000 USD	
5000 to 10000 USD	
Over 10000 USD	
I don't want to answer	

For tourist

0 to 500 USD	
500 to 1000 USD	
1000 to 2000 USD	
2000 to 5000 USD	
5000 to 10000 USD	
Over 10000 USD	
I don't want to answer	

22. Your profession

Unemployed	
Self-employed	
Government employee	
Private employee	
Retired	
Students	
Others (Please specify)	
I don't want to answer	

A.5 PART IV: PERSONAL PREFERENCES

Now I would like to ask you some final short questions regarding your preferences.
24. How do you see yourself: are you a person who is generally *willing to take risks*, or do you try to *avoid taking risks*?
Please use a scale from 0 to 10, where a 0 means you are "completely unwilling to take risks" and a 10 means you are "very willing to take risks".

1	2	3	4	5	6	7	8	9	10

25. In comparison to others, are you a person who is generally willing to give up something today in order to benefit from that in the future or are you not willing to do so?
Please use a scale from 0 to 10, where a 0 means you are "completely unwilling to give up something today" and a 10 means you are "very willing to give up something today".

1	2	3	4	5	6	7	8	9	10

26. How well does the following statement describe you as a person? "As long as I am not convinced otherwise, I assume that people have only the best intentions".
Please use a scale from 0 to 10, where 0 means "does not describe me at all" and 10 means "describes me perfectly".

1	2	3	4	5	6	7	8	9	10

27. How do you assess your willingness to share with others without expecting anything in return when it comes to charity?
Please use a scale from 0 to 10, where 0 means you are "completely unwilling to share" and a 10 means you are "very willing to share".

1	2	3	4	5	6	7	8	9	10

28. Generally speaking, how concerned are you about environmental issues?
By "concerned about" we mean being worried about environmental issues. Please use a scale from 1 to 5, where 1 means you are not at all concerned and 5 means you are very concerned.

1	2	3	4	5

29. Which of these approaches do you think would be the best way of getting people and their families in your country to protect the environment?

Heavy fines for people who damage the environment	
Use the tax system to reward people who protect the environment	
More information and education for people about the advantages of protecting the environment	
Can't choose	

30. Your opinion about this survey

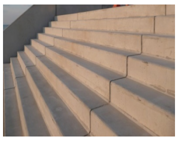
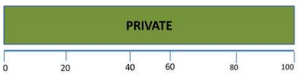
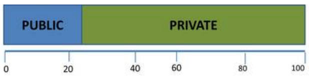
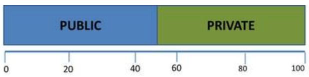
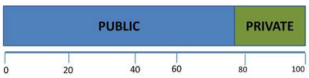
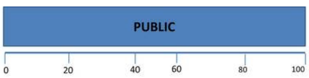
Interesting	
Too long	
Difficult to understand	
Unrealistic	
I need more information than was provided	
Others	

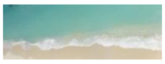
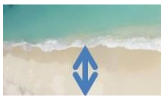
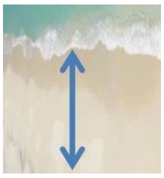
End survey time

Appendix B

Description of attributes in the DCE

Table B.1: Description of attributes and levels in the DCE

Attributes/Levels	Image	Description
Protection Structure		Type of hard or soft protection structures that must be built along the coastline to fight against and prevent erosion
Concrete Revetment		An embankment made by concrete
Stair Revetment		A concrete embankment with a stair shape
Groynes		A concrete structure extending from shoreline to the sea and interrupts water flow
Sandbag		A bag filled with sand
Nothing		There is no structure built on the beach, but the beach can still be protected by adding regularly more sand to the beach
Public Access		Percentage of the beach with public access and totally free access to all people
0% public		
25% public		
50% public		
75% public		
100% public		

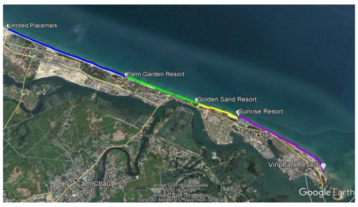
Attributes/Levels	Image	Description
Beach width		Average width of the beach at high tide. Compared to the current situation, the width is increased using beach nourishment
0 meter		
25 meters		
50 meters		
75 meters		
100 meters		
150 meters		
Recreational offers and facilities		Type of recreational offers and facilities presented in the beach
Nothing	**Nothing**	
Tree public		
Restaurant		
Restaurant and Trees		
Payment Vehicles		All the money collected from this tax will be dedicated to coastal erosion reduction resident: Tax will be paid by each resident in Hội An from 18 to 60 years old per year Visitor: Tax will be paid by each visitor from 18 years old per each trip to Hội An For visitors ($): 0, 2, 4, 6, 8, 10, or 15 For residents (thousand VND): 0, 50, 100, 150, or 200 (equal to $0, 2.2, 4.4, 6.7, and 8.9)

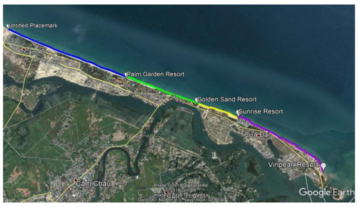
Appendix C

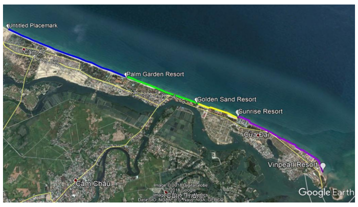
Videos presented in the DCE

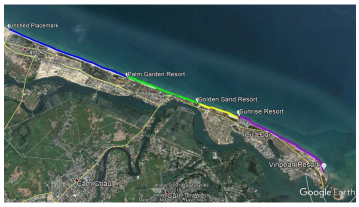
C.1 Video 1: Introduction of erosion in Hoian

C.2 Video 2: Introduction of beach segments

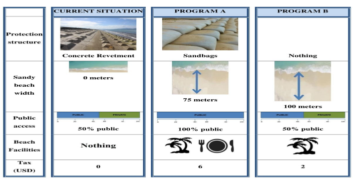
Beach A 

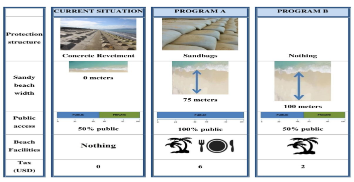
Beach B 

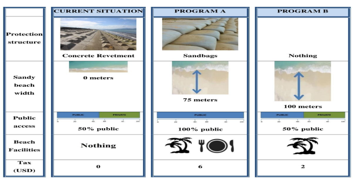
Beach C 

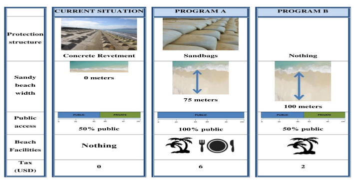
Beach D 

C.3 Video 3: Introduction of characteristics of a coastal protection program

Beach A 

Beach B 

Beach C 

Beach D 

Appendix D

Definition of variables used in estimation

Table D.1: Variable definitions

Variables	Description	Value
Part I: Attribute variables		
ASC	Current Situation of the beach	Dummy Variable: = 1 if the Current Situation is chosen = 0 if NOT
Width	Average width of the beach at high tide	Continuous variable (in meters)
Access	Share of the beach that is public with free access to all people	Continuous variable (in percentage)
Tax	Tax paid for coastal erosion management	Continuous variable (in USD)
Protection Structure	Type of structures built along the coastline: Sandbags, Concrete Revetment, Stairs Revetment, or Groynes	Dummy Variables: = 1 if the structure is chosen, and = 0 if NOT
Recreational Offers and Facilities	Type of recreational offers and facilities presented along the coastline: Trees-Restaurant, Restaurant, or Trees	Dummy Variables: = 1 if the facility is chosen, and = 0 if NOT
Part II: Respondent characteristics		
High-income		Dummy variable: = 1 if resident who has monthly household income more than 10 million VND, and = 0 otherwise
Children		Dummy variable: = 1 if resident who has more than one child below 18 years old, and = 0 otherwise
Beach user		Dummy variable: = 1 if resident who visited the valued beach more than one time last year, and = 0 otherwise

Appendix E

Pooled model with group-specific preferences by beach segment

E.1 MIXL estimates

Table E.1: MIXL estimation of pooled model with group-specific preferences by beach segment

	Beach A			Beach B			Beach C			Beach D		
	Residents	Tourists	Differences	Residents	Tourists	Differences	Residents	Tourists	Differences	Residents	Tourists	Differences
Mean of Random Parameters												
Access	0.004(0.003)	0.023(0.007)**	-0.019(0.009)**	0.005(0.003)**	0.028(0.006)**	-0.023(0.006)**	0.011(0.003)**	0.029(0.008)**	-0.018(0.008)**	0.012(0.005)**	0.011(0.005)**	0.001(0.008)
ASC	0.061(0.508)	-2.236(0.858)**	2.296(0.998)**	-0.271(0.464)	0.082(0.509)	-0.353(0.638)	0.011(0.474)	0.267(0.755)	-0.256(0.912)	-0.875(0.595)	-0.735(0.745)	-0.14(0.926)
Recreational offers and facilities (ref. is *Nothing*)												
- *Restaurant*	-0.231(0.404)	0.053(0.512)	-0.284(0.712)	0.405(0.31)	-0.326(0.365)	0.731(0.538)	0.462(0.289)	-0.355(0.51)	0.817(0.57)	-0.036(0.249)	-0.775(0.537)	0.739(0.7)
- *Restaurant-Tree*	0.554(0.318)*	0.22(0.445)	0.334(0.562)	0.995(0.283)**	0.716(0.362)**	0.279(0.529)	0.607(0.352)*	-0.278(0.429)	0.885(0.6)	0.849(0.446)*	0.632(0.453)	0.216(0.606)
- *Tree*	-0.028(0.295)	0.585(0.518)	-0.613(0.659)	0.352(0.306)	0.097(0.334)	0.255(0.478)	0.057(0.308)	0.614(0.369)*	-0.557(0.532)	0.127(0.313)	0.526(0.395)	-0.399(0.512)
Protection structure (ref. is *Nothing*)												
- *Groynes*	1.128(0.318)**	1.378(0.601)**	-0.251(0.679)	0.544(0.447)	0.763(0.418)*	-0.219(0.651)	0.125(0.401)	0.139(0.431)	-0.014(0.665)	1.368(0.37)**	2.245(0.558)**	-0.878(0.636)
- *Concrete Revetment*	-0.12(0.335)	1.149(0.472)**	-1.269(0.612)**	0.997(0.433)**	1.374(0.461)**	-0.377(0.657)	0.232(0.342)	1.149(0.543)**	-0.917(0.73)	0.995(0.513)*	1.411(0.712)**	-0.416(1.044)
- *Stair Revetment*	-0.556(0.438)	1.198(0.508)**	-1.754(0.712)**	1.254(0.404)**	0.625(0.481)	0.629(0.646)	0.261(0.388)	0.161(0.779)	0.1(0.928)	0.887(0.397)**	1.629(0.521)**	-0.741(0.71)
- *Sandbags*	0.87(0.394)**	0.507(0.439)	0.363(0.608)	0.696(0.39)*	0.937(0.478)*	-0.241(0.633)	0.322(0.375)	-0.38(0.433)	0.702(0.587)	0.833(0.416)**	1.275(0.603)**	-0.441(0.769)
Width	0.008(0.002)**			0.007(0.002)**			0.01(0.002)**			0.003(0.002)*		
Standard deviation of Random Parameters												
Access	-0.019(0.006)**	0.024(0.008)**	-0.042(0.012)**	-0.011(0.005)**	-0.018(0.007)**	0.007(0.008)	0.002(0.007)	-0.022(0.011)**	0.024(0.01)**	0.028(0.007)**	0.017(0.008)**	0.012(0.014)
ASC	2.325(0.384)**	2.147(0.664)**	0.179(0.958)	1.535(0.383)**	1.204(0.423)**	0.331(0.7)	0.876(0.432)**	3.285(1.01)**	-2.409(1.058)**	1.833(0.426)**	1.26(0.524)**	0.573(0.784)
Recreational offers and facilities (ref. is *Nothing*)												
- *Restaurant*	-1.083(0.603)*	1.106(0.619)*	-2.189(1.154)*	0.956(0.447)**	0.419(0.833)	0.537(0.834)	0.338(0.656)	1.663(0.665)**	-1.325(0.947)	0.314(0.617)	-0.472(0.975)	0.786(1.179)
- *Restaurant-Tree*	-0.431(0.682)	1.202(0.475)**	-1.633(0.833)**	0.886(0.319)**	0.502(1.033)	0.385(1.092)	0.777(0.329)**	-0.175(0.578)	0.952(0.494)*	1.233(0.419)**	1.327(0.464)**	-0.094(0.734)
- *Tree*	1.303(0.444)**	0.294(0.842)	1.009(0.917)	-0.414(0.324)	1.03(0.407)**	-1.444(0.47)**	-0.148(0.496)	0.553(0.677)	-0.701(0.609)	0.823(0.603)	0.87(0.663)	-0.046(1.018)
Protection structure (ref. is *Nothing*)												
- *Groynes*	0.799(0.469)*	-2.162(1.056)**	2.961(1.437)**	1.106(0.656)*	1.43(0.483)**	-0.324(0.82)	1.654(0.618)**	0.977(0.68)	0.677(0.828)	-0.051(0.425)	-0.758(0.883)	0.707(0.839)
- *Concrete Revetment*	0.194(0.595)	-0.021(0.865)	0.215(0.818)	1.864(0.419)**	1.089(0.517)**	0.776(0.634)	0.938(0.616)	1.632(0.881)*	-0.694(1.236)	1.887(0.803)**	1.669(1.423)	0.219(1.784)
- *Stair Revetment*	1.652(0.558)**	-0.583(0.938)	2.235(1.254)*	1.014(0.713)	-0.316(0.75)	1.33(1.16)	1.521(0.533)**	2.524(1.03)**	-1.003(1)	1.267(0.593)**	-0.678(0.614)	1.945(0.824)**
- *Sandbags*	1.754(0.591)**	-0.858(0.96)	2.612(1.559)*	1.431(0.417)**	-0.719(0.749)	2.15(0.902)**	1.414(0.317)**	-0.88(0.627)	2.294(0.71)**	0.746(0.896)	1.783(0.666)**	-1.037(1.251)
Width	-0.003(0.007)			-0.008(0.003)**			-0.004(0.005)			-0.001(0.006)		
Non-random parameter												
Tax	-0.201(0.046)**	-0.052(0.033)	-0.149(0.072)**	-0.226(0.04)**	-0.086(0.029)**	-0.141(0.063)**	-0.16(0.042)**	-0.039(0.037)	-0.122(0.058)**	-0.205(0.041)**	-0.159(0.044)**	-0.046(0.067)
Standard deviation of Error Component												
ζ	0.654(0.246)**			0.144(0.411)			-0.223(0.232)			0.591(0.227)**		
Observed choices	834			990			702			828		
Number of respondents	139			165			117			138		
Log Likelihood	-742.85			-912.08			-633.19			-703.70		
LR test-value$^{(a)}$	74.26***			49.9***			48.54***			23.74		
Degrees of freedom	20			20			20			20		

(a) LR test of the pooled model with similar preferences and group-specific preferences

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

E.2 Marginal WTP

Table E.2: Marginal WTP for coastal erosion management for segment A

	Pooled model[a]		Pooled model with group-specific preferences			
			Residents		Tourists	
	Mean *	% Positive**	Mean *	% Positive**	Mean *	% Positive**
Access	0.102	72.26	0.02	58.84	0.443	83.23
	(-0.179, 0.386)		(-0.134, 0.173)		(-0.301, 1.196)	
ASC	-6.191	40.76	0.374	51.22	-42.736	15.12
	(-50.809, 38.944)		(-18.623, 19.591)		(-110.463, 25.776)	
Recreational offers and facilities (ref. is *Nothing)*						
- *Restaurant*	3.348	62.83	-1.182	40.96	1.15	52.18
	(-13.783, 20.678)		(-10.13, 7.664)		(-33.737, 36.44)	
- *Restaurant-tree*	5.075	67.87	2.743	90.04	4.37	57.77
	(-12.582, 22.936)		(-0.818, 6.263)		(-33.556, 42.736)	
- *Restaurant-tree*	2.351	64.08	-0.1	49.37	11.281	97.79
	(-8.377, 13.204)		(-10.742, 10.665)		(2.008, 20.662)	
Protection structure (ref. is *Nothing)*						
- *Groynes*	12.066	89.37	5.64	92.19	26.245	73.49
	(-3.67, 27.985)		(-0.888, 12.244)		(-42.754, 94.453)	
- *Concrete revetment*	4.575	99.95	-0.592	27.01	22.095	100
	(2.381, 6.795)		(-2.176, 1.011)		(21.43, 22.752)	
- *Stair revetment*	5.56	79.57	-2.718	37.04	22.963	97.98
	(-5.288, 16.534)		(-16.212, 10.932)		(4.354, 41.36)	
- *Sandbags*	7.383	71.17	4.384	69.07	9.64	71.93
	(-14.094, 29.108)		(-9.942, 18.876)		(-17.751, 36.717)	
Width	0.066	87.48	0.038	99.57	0.146	99.57
	(-0.027, 0.159)		(0.014, 0.062)		(0.053, 0.238)	

[a]Pooled model with similar preference between tourists and residents
*95% confidence interval is reported below the mean
**% of sample has positive WTP

Table E.3: Marginal WTP for coastal erosion management for segment B

	Pooled model[a]		Pooled model with group-specific preferences			
			Residents		Tourists	
	Mean *	% Positive**	Mean *	% Positive**	Mean *	% Positive**
Access	0.07	81.51	0.023	68.23	0.331	94.2
	(-0.056, 0.198)		(-0.057, 0.103)		(-0.016, 0.674)	
ASC	-2.557	38.36	-1.155	43.21	1.043	52.98
	(-17.019, 12.072)		(-12.282, 10.101)		(-22.052, 24.405)	
Recreational offers and facilities (ref. is *Nothing)*						
- *Restaurant*	1.638	62.42	1.817	66.39	-3.784	22.26
	(-7.017, 10.392)		(-5.112, 8.826)		(-11.815, 4.341)	
- *Restaurant-tree*	5.258	97.16	4.421	86.69	8.413	92.43
	(0.707, 9.757)		(-2.003, 10.921)		(-1.208, 18.146)	
- *Restaurant-tree*	1.884	65.19	1.543	79.78	1.205	53.97
	(-5.986, 9.845)		(-1.492, 4.545)		(-18.557, 21.197)	
Protection structure (ref. is *Nothing)*						
- *Groynes*	2.874	71.85	2.435	68.9	9.022	70.41
	(-5.198, 11.04)		(-5.587, 10.55)		(-18.412, 36.773)	
- *Concrete revetment*	4.758	66.9	4.459	70.44	16.146	89.68
	(-12.76, 22.479)		(-9.058, 18.132)		(-4.738, 37.272)	
- *Stair revetment*	5.784	77.49	5.569	88.97	7.284	97.54
	(-6.53, 18.241)		(-1.782, 13.005)		(1.155, 13.342)	
- *Sandbags*	3.159	69.1	3.115	68.71	10.903	90.26
	(-7.157, 13.595)		(-7.26, 13.61)		(-3.047, 24.692)	
Width	0.042	79.16	0.03	78.6	0.079	78.6
	(-0.041, 0.125)		(-0.032, 0.091)		(-0.085, 0.242)	

[a]Pooled model with similar preference between tourists and residents
*95% confidence interval is reported below the mean
**% of sample has positive WTP

Table E.4: Marginal WTP for coastal erosion management for segment C

	Pooled model[a]		Pooled model with group-specific preferences			
			Residents		Tourists	
	Mean *	% Positive**	Mean *	% Positive**	Mean *	% Positive**
Access	0.224	99.96	0.069	100	0.735	90.49
	(0.116, 0.331)		(0.049, 0.089)		(-0.195, 1.654)	
ASC	6.546	62	0.102	50.65	7.408	53.57
	(-29.73, 43.243)		(-8.855, 9.163)		(-131.461, 147.886)	
Recreational offers and facilities (ref. is *Nothing)*						
- *Restaurant*	2.629	59.17	2.893	91.42	-8.888	41.62
	(-16.755, 22.237)		(-0.567, 6.393)		(-79.196, 62.234)	
- *Restaurant-tree*	2.926	71.76	3.813	78.11	-7.191	5.43
	(-5.456, 11.213)		(-4.134, 11.851)		(-14.656, 0.188)	
- *Restaurant-tree*	3.567	77.07	0.349	64.45	15.917	86.44
	(-4.289, 11.334)		(-1.18, 1.861)		(-7.47, 39.576)	
Protection structure (ref. is *Nothing)*						
- *Groynes*	2.334	56.43	0.841	53.31	3.74	56.14
	(-22.489, 27.445)		(-16.075, 17.954)		(-37.554, 45.512)	
- *Concrete revetment*	7.522	71.66	1.482	60.3	29.87	75.78
	(-13.759, 29.05)		(-8.109, 11.184)		(-39.12, 99.66)	
- *Stair revetment*	5.852	63.59	1.687	57.27	4.564	52.84
	(-22.016, 34.042)		(-13.87, 17.425)		(-102.134, 112.5)	
- *Sandbags*	0.637	51.32	2.062	59.66	-9.939	33.35
	(-29.729, 31.356)		(-12.394, 16.687)		(-47.568, 27.259)	
Width	0.124	99.96	0.06	99.57	0.247	99.57
	(0.064, 0.184)		(0.021, 0.097)		(0.089, 0.403)	

[a]Pooled model with similar preference between tourists and residents
*95% confidence interval is reported below the mean
**% of sample has positive WTP

Table E.5: Marginal WTP for coastal erosion management for segment D

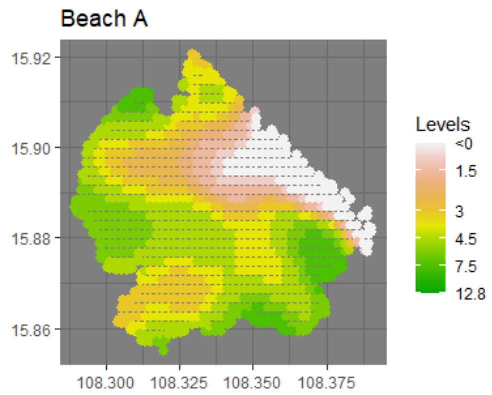
	Pooled model[a]		Pooled model with group-specific preferences			
			Residents		Tourists	
	Mean *	% Positive**	Mean *	% Positive**	Mean *	% Positive**
Access	0.084	71.38	0.061	66.73	0.069	74.17
	(-0.157, 0.327)		(-0.166, 0.291)		(-0.102, 0.242)	
ASC	-5.092	33.8	-4.205	32.15	-4.568	28.34
	(-24.702, 14.744)		(-18.852, 10.612)		(-17.568, 8.582)	
Recreational offers and facilities (ref. is *Nothing)*						
- *Restaurant*	-1.725	22.68	-0.165	45.71	-4.891	4.93
	(-5.453, 2.045)		(-2.674, 2.373)		(-9.818, -0.02)	
- *Restaurant-tree*	5.776	77.96	4.171	75.21	4.027	68.27
	(-6.328, 18.02)		(-5.681, 14.137)		(-9.663, 17.876)	
- *Restaurant-tree*	3.036	66.5	0.643	56.67	3.338	72.78
	(-8.45, 14.656)		(-5.937, 7.299)		(-5.63, 12.411)	
Protection structure (ref. is *Nothing)*						
- *Groynes*	11.646	100	6.66	100	14.086	99.87
	(10.773, 12.53)		(6.25, 7.065)		(6.176, 21.906)	
- *Concrete revetment*	7.75	72.47	4.905	70.17	8.937	79.88
	(-13.324, 29.069)		(-10.176, 20.161)		(-8.273, 26.347)	
- *Stair revetment*	8.47	92.72	4.361	75.64	10.211	99.27
	(-1.049, 18.1)		(-5.762, 14.601)		(3.132, 17.209)	
- *Sandbags*	7.143	84.09	4.081	86.57	8.083	76.05
	(-4.365, 18.783)		(-1.877, 10.109)		(-10.307, 26.686)	
Width	0.023	87.03	0.017	100	0.021	100
	(-0.01, 0.057)		(0.012, 0.021)		(0.015, 0.027)	

[a]Pooled model with similar preference between tourists and residents
*95% confidence interval is reported below the mean
**% of sample has positive WTP

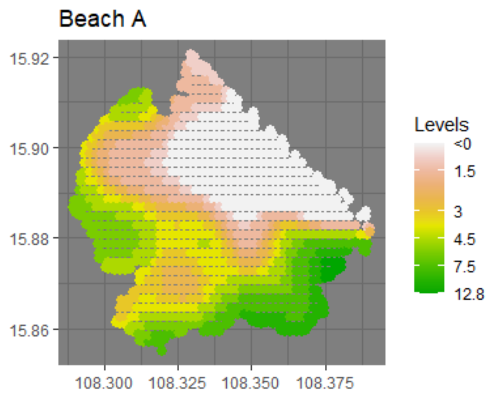
Appendix F

Maps of WTP by beach segment for implementing a coastal erosion management program (multi-directional decay function and observed individual heterogeneity)

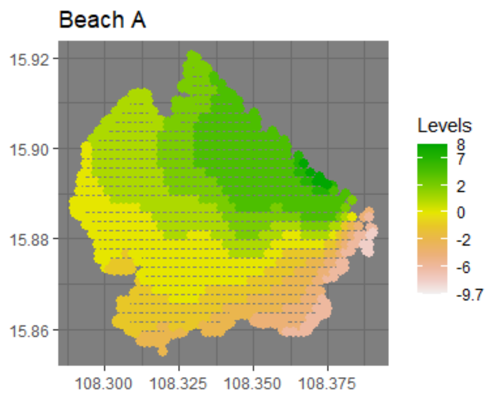
F.1 Observed individual heterogeneity: respondent usage of beach



(a) Beach user

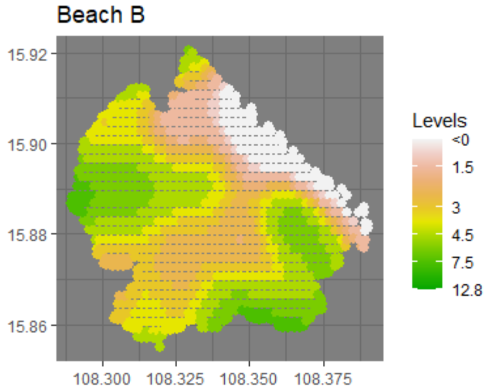


(b) Beach non-user

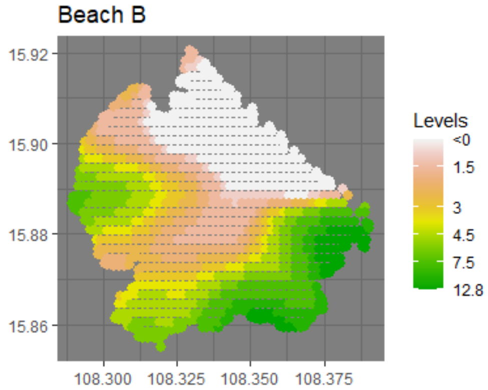


(c) Difference of WTP between two groups

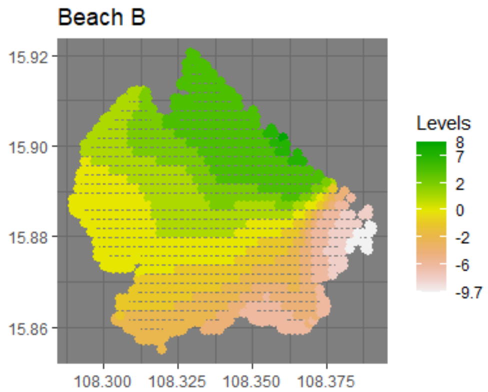
Figure F.1: WTP for beach segment A for implementing a coastal erosion management program (MIXL model with multi-directional decay function controlling for user of beach)



(a) Beach user

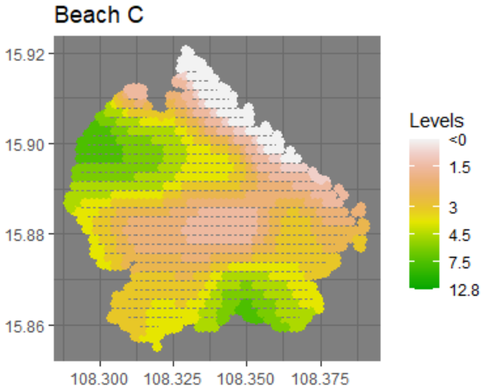


(b) Beach non-user

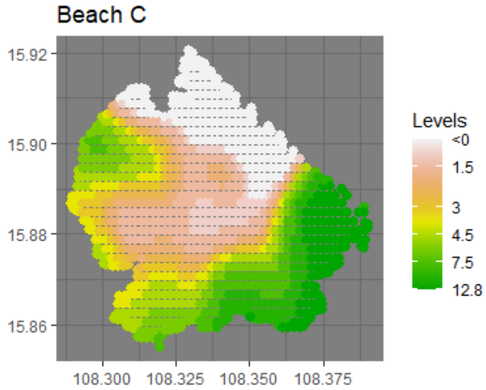


(c) Difference of WTP between two groups

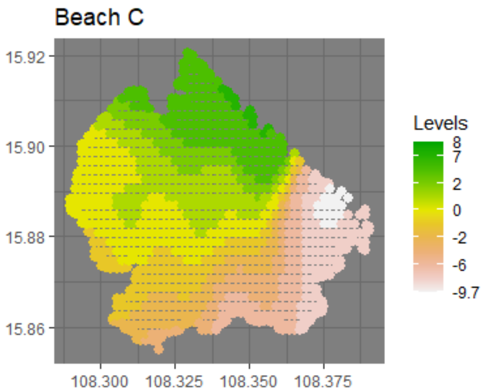
Figure F.2: WTP for beach segment B for implementing a coastal erosion management program (MIXL model with multi-directional decay function controlling for user of beach)



(a) Beach user

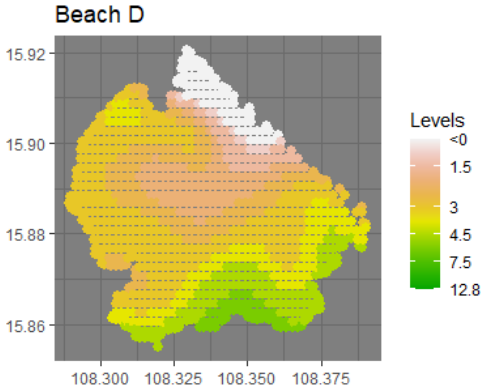


(b) Beach non-user

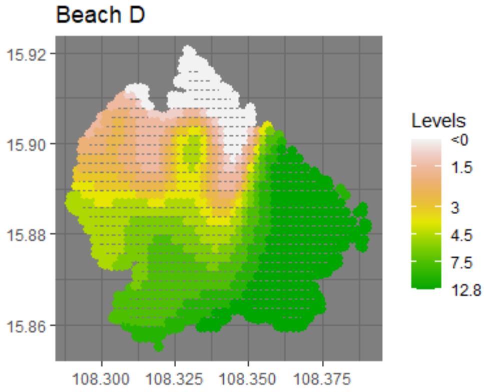


(c) Difference of WTP between two groups

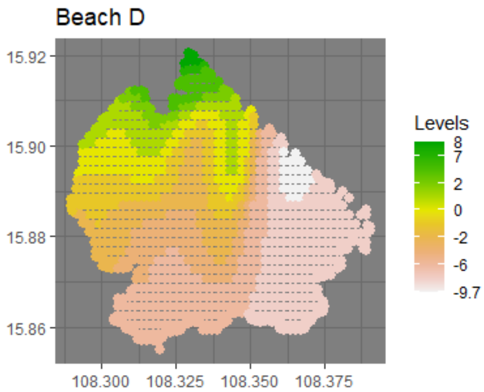
Figure F.3: WTP for beach segment C for implementing a coastal erosion management program (MIXL model with multi-directional decay function controlling for user of beach)



(a) Beach user



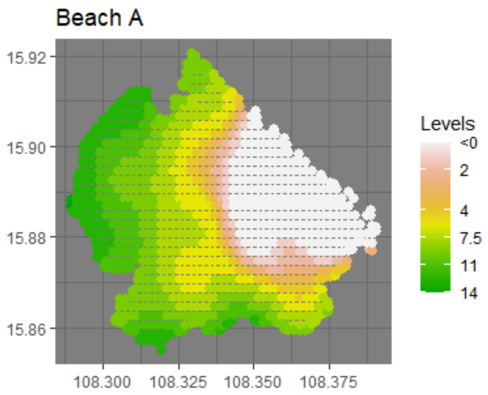
(b) Beach non-user



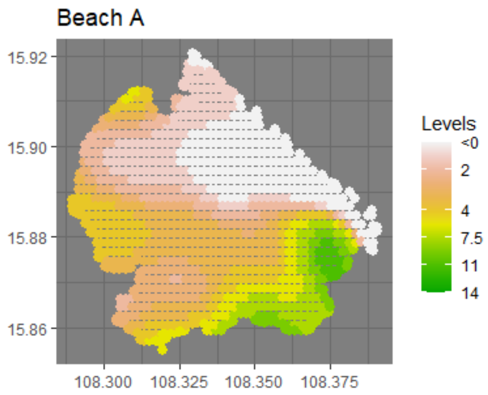
(c) Difference of WTP between two groups

Figure F.4: WTP for beach segment D for implementing a coastal erosion management program (MIXL model with multi-directional decay function controlling for user of beach)

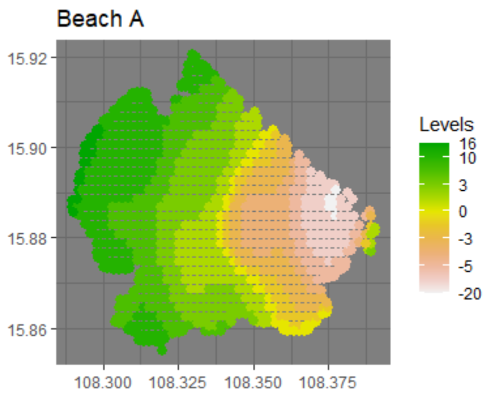
F.2 Observed individual heterogeneity: respondent income



(a) High-income residents

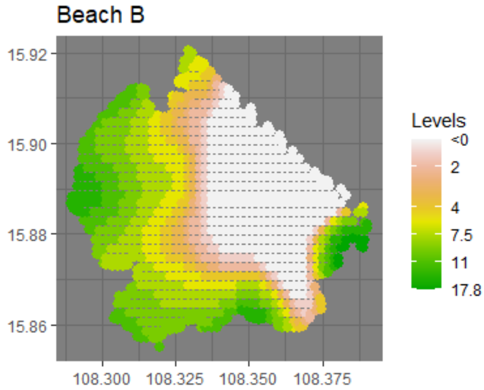


(b) Low-income residents

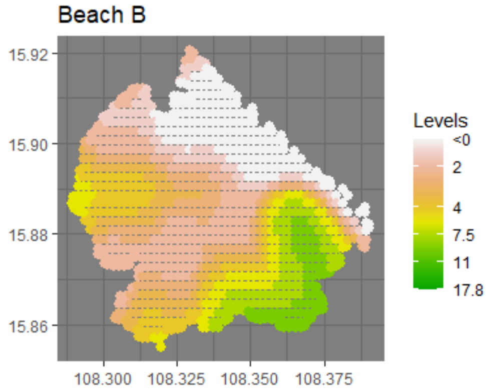


(c) Difference of WTP between two groups

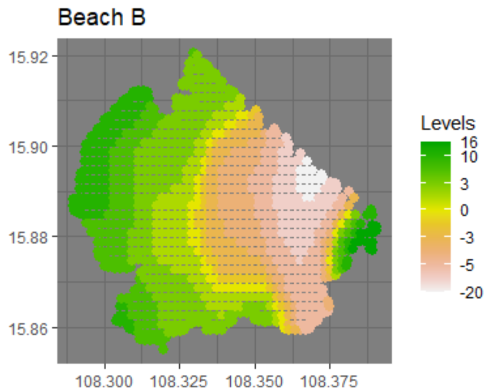
Figure F.5: WTP for beach segment A for implementing a coastal erosion management program (MIXL model with multi-directional decay function controlling for respondent income)



(a) High-income residents

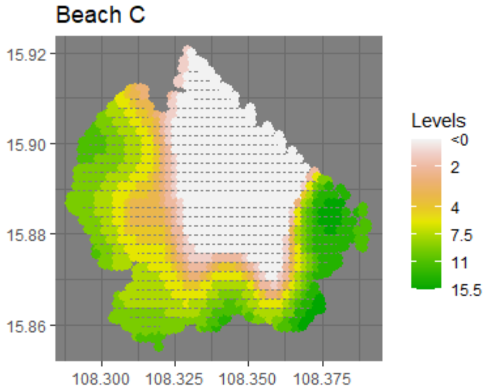


(b) Low-income residents

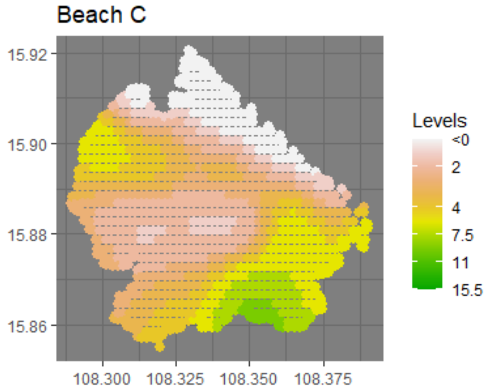


(c) Difference of WTP between two groups

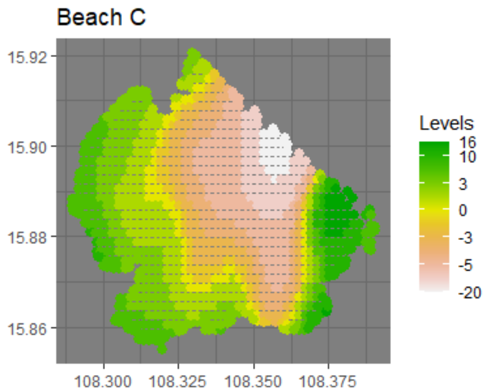
Figure F.6: WTP for beach segment B for implementing a coastal erosion management program (MIXL model with multi-directional decay function controlling for respondent income)



(a) High-income residents

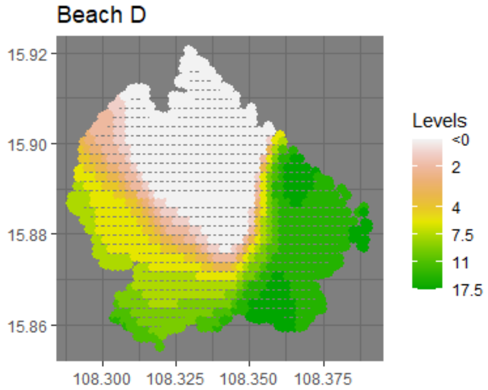


(b) Low-income residents

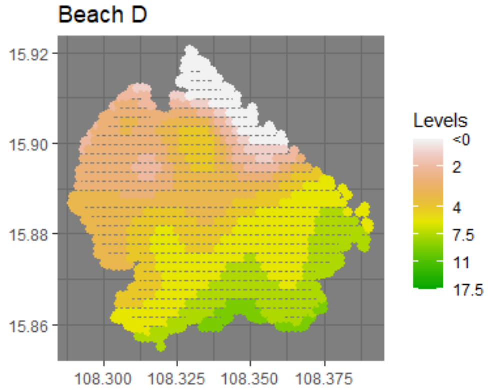


(c) Difference of WTP between two groups

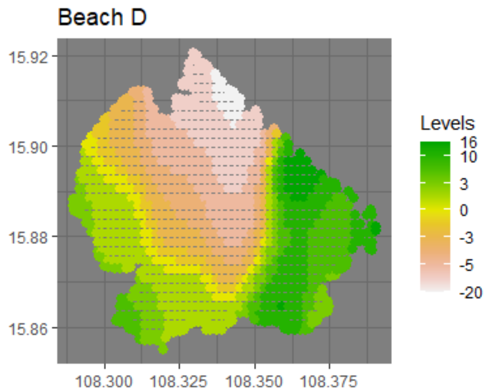
Figure F.7: WTP for beach segment C for implementing a coastal erosion management program (MIXL model with multi-directional decay function controlling for respondent income)



(a) High-income residents



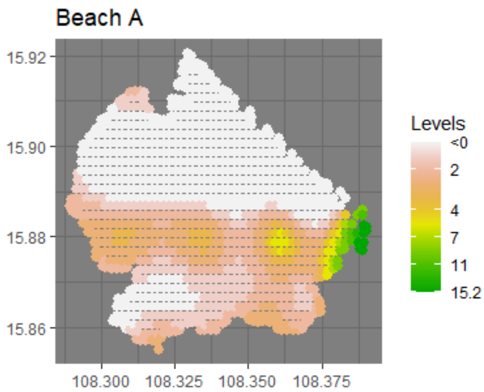
(b) Low-income residents



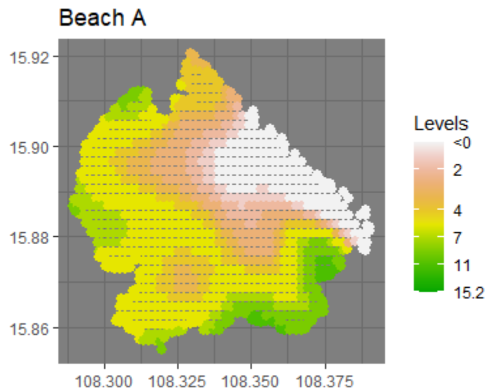
(c) Difference of WTP between two groups

Figure F.8: WTP for beach segment D for implementing a coastal erosion management program (MIXL model with multi-directional decay function controlling for respondent income)

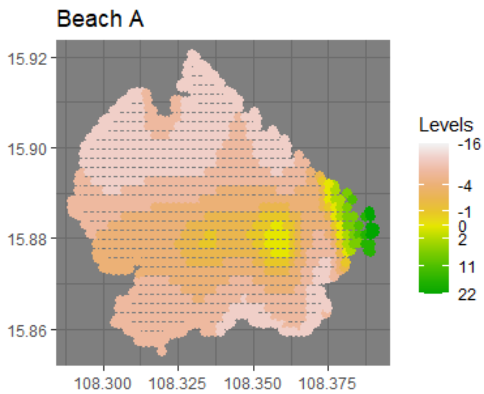
F.3 Observed individual heterogeneity: respondents having children



(a) Having more children

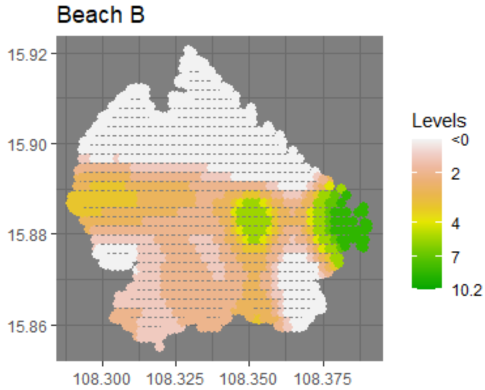


(b) Having less children

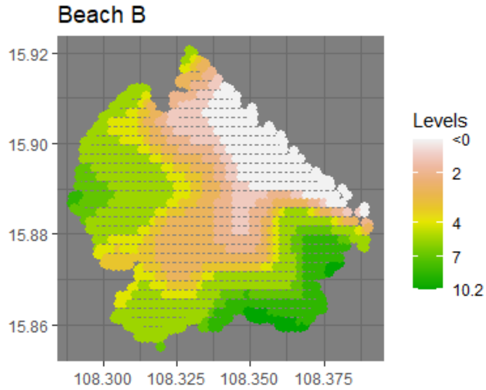


(c) Difference of WTP between two groups

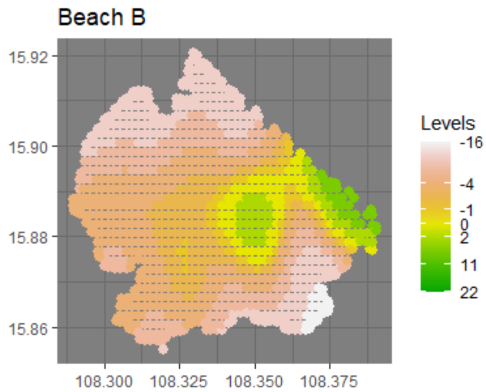
Figure F.9: WTP for beach segment A for implementing a coastal erosion management program (MIXL model with multi-directional decay function controlling for respondents having children)



(a) Having more children

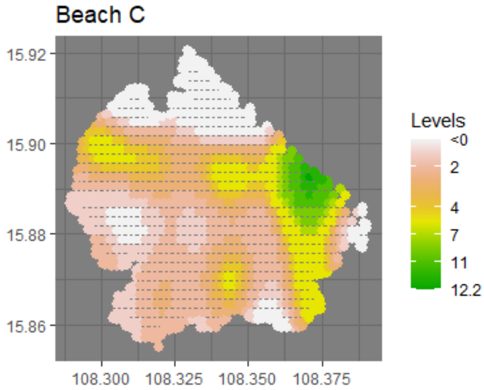


(b) Having less children

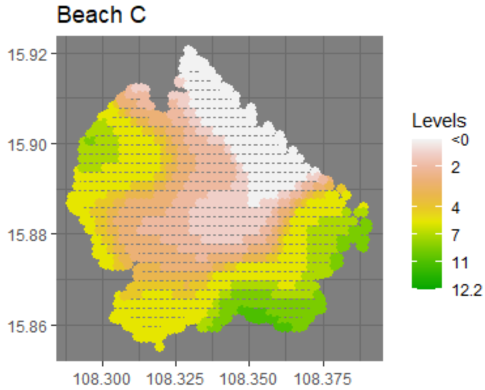


(c) Difference of WTP between two groups

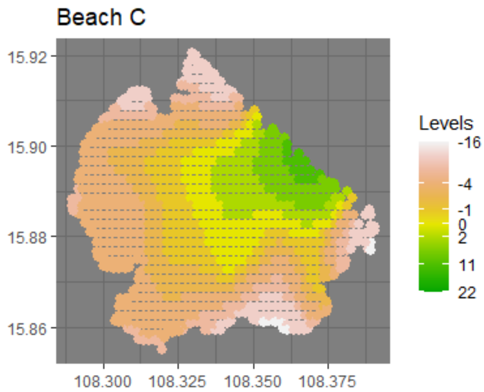
Figure F.10: WTP for beach segment B for implementing a coastal erosion management program (MIXL model with multi-directional decay function controlling for respondents having children)



(a) Having more children

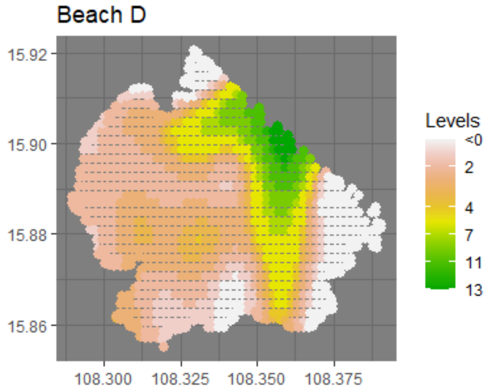


(b) Having less children

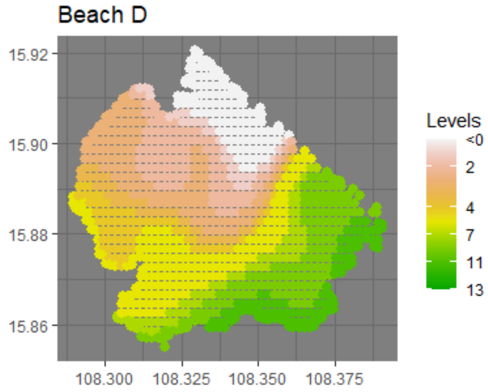


(c) Difference of WTP between two groups

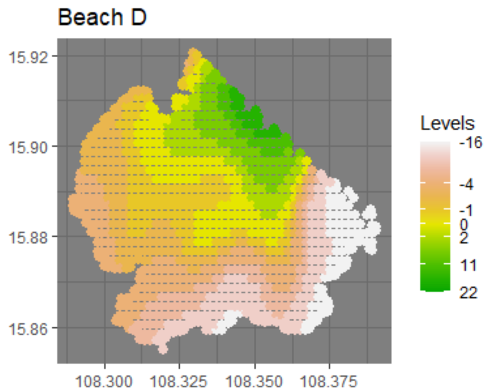
Figure F.11: WTP for beach segment C for implementing a coastal erosion management program (MIXL model with multi-directional decay function controlling for respondents having children)



(a) Having more children



(b) Having less children



(c) Difference of WTP between two groups

Figure F.12: WTP for beach segment D for implementing a coastal erosion management program (MIXL model with multi-directional decay function controlling for respondents having children)